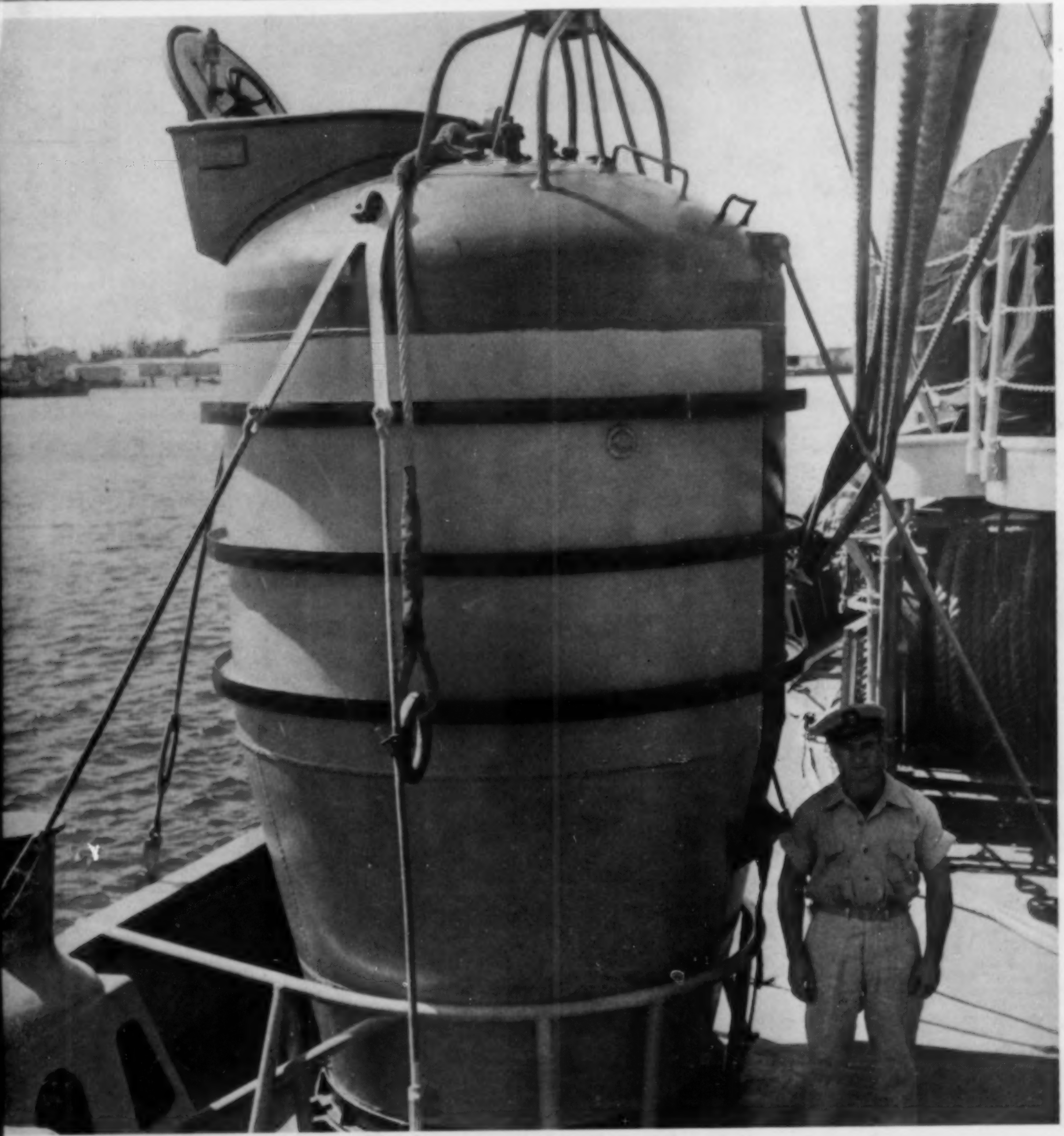
PERMANENT FILE
IR
LITERATURE
Return this copy to
Advertising Division
Ingersoll-Rand
Phillipsburg, New Jersey
File Jan 1953
X-1850 IR 2M 10-54 PRINTED IN U. S. A.

# essed Air
## Magazine



OFFICIAL U. S. NAVY PHOTO

**DIVING BELL THAT AIDS SUNKEN SUBS**

**Serves as elevator between mother ship and helpless vessel on sea bottom**

(SEE INDEX PAGE AND PAGE 17)

VOLUME 58 • NUMBER 1
NEW YORK • LONDON

# Air Casualties

***It's bad air that does it. But you can step up production by putting a Coppus Blower on the job to keep the air moving — and keep the men cool.***

The kind of air a man works in has a lot to do with how much work he can turn out.

In confined places like shipholds or tanks or drums or boilers . . . or wherever the air is stagnant or hot or full of fumes . . . a Coppus Blower is a *must* for getting first-class work out of the men, all the time.

A Coppus Blower or Exhauster helps avoid sickness and lassitude due to bad air . . . and improves morale, too.

Portable and adaptable for special purposes, Coppus Blowers and Exhausters will have dozens of uses around your plant. The "Blue Ribbon" (a blue painted band) is your assurance of quality performance at lowest cost.

**COPPUS**

**BLUE RIBBON BLOWERS**

***THE BLOWERS THAT PUT MORE MINUTES IN EVERY MAN-HOUR***

**CABLE MANHOLE AND TANK VENTILATORS — BOILER MANHOLE BLOWERS AND EXHAUSTERS — HEAT KILLERS — SHIPHOLD VENTILATORS . . . DESIGNED FOR YOUR INDUSTRY — ENGINEERED FOR YOU**

***MAIL THIS COUPON*** To Coppus Engineering Corp., 201 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY.

**PLEASE SEND ME INFORMATION ON SUPPLYING FRESH AIR TO MEN WORKING:**

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fusilages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.
- ☐ drying of walls, sheets, etc., after treated with coating material.

NAME.................................................

COMPANY..........................................

ADDRESS...........................................

CITY..................................................

(Write here any special ventilating problem you may have.)

# STAYNEW

# ABSORPTION FILTERS PROVIDE

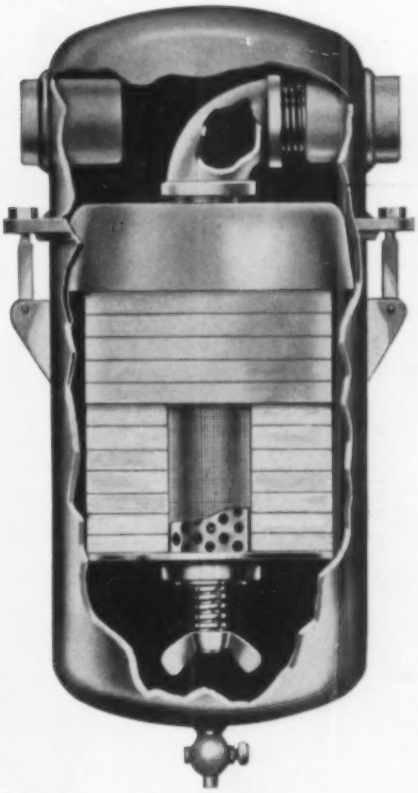
# SUPER FILTRATION!

## —REMOVE LAST TRACES OF OIL AND MOISTURE FROM COMPRESSED AIR LINES

The model AAPH Absorption Type Filter has proven itself to be the real answer to the elimination of costly service interruptions in utility and industrial power plants. Many manufacturing processes and certain compressed air operated equipment require the removal of condensed oil and water vapors *completely* from the compressed air. In thousands of installations all over the country, Staynew Absorption Filters remove the last traces of oil and moisture and prevent failure of combustion and other pneumatic controls . . . keep maintenance time and cost at a minimum.

*For Complete Information, Write Today For Bulletin B-1A*

Representatives in Principal Cities



MODEL AAPH
Absorption Filter

DOLLINGER
REG. PROTECTOMOTOR U S PAT OFF
STAYNEW FILTERS

# DOLLINGER
**CORPORATION**

7 Centre Pk., Rochester 3, N. Y.

**ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED**

IN CANADA: Toronto - McCarthy & Robinson, Ltd.
Montreal - Engineering Equipment Co., Ltd.
Vancouver - P. D. McLaren & Sons, Ltd.
Winnipeg - Mumford-Medland, Ltd.

# EIMCO 2-Speed AIR LOCOMOTIVE

*for*

- SMALL MINES
- CONSTRUCTION JOBS
- GATHERING
- EXPLORATION DRIFTS
- SWITCHING
- and many other uses

The Eimco Air Locomotive is the answer to economical car handling underground. Eimco has developed the first two-speed, constant-mesh transmission to be used on any air locomotive. Starting in low gear to get the load in motion you shift immediately into high gear.

**ADVANTAGE**
**This means you get more haulage distance per cubic foot of air consumed.**

There are many other advantages in the Eimco Air Locomotive. Here are a few:

1. Longer hauls with greater load. 2. Two speeds forward and reverse. 3. Neutral for free wheeling. 4. Articulating axle assembly. 5. Efficient Eimco made air motor. 6. Registered ASME code receiver. 7. Parking brake. 8. Safety centering throttle.

EIMCO

A421

**THE EIMCO CORPORATION**

*The World's Largest Manufacturers of Underground Rock Loading Machines*

EXECUTIVE OFFICES AND FACTORIES — SALT LAKE CITY 10, UTAH, U. S. A.

*BRANCH SALES AND SERVICE OFFICES:*

NEW YORK, 51-52 SOUTH STREET • CHICAGO, 3319 SOUTH WALLACE STREET
BIRMINGHAM, ALA., 3140 FAYETTE AVE • DULUTH, MINN., 216 E. SUPERIOR ST.
EL PASO, TEXAS, MILLS BUILDING • BERKELEY, CALIF., 637 CEDAR STREET
KELLOGG, IDAHO, 307 DIVISION ST. • LONDON W. 1, ENGLAND, 190 PICCADILLY

IN FRANCE: SOCIETE EIMCO, PARIS, FRANCE
IN ENGLAND: EIMCO (GREAT BRITAIN) LTD., LEEDS 12, ENGLAND
IN ITALY: EIMCO ITALIA, S.P.A., MILAN, ITALY

***"All Motors are NOT Alike"***

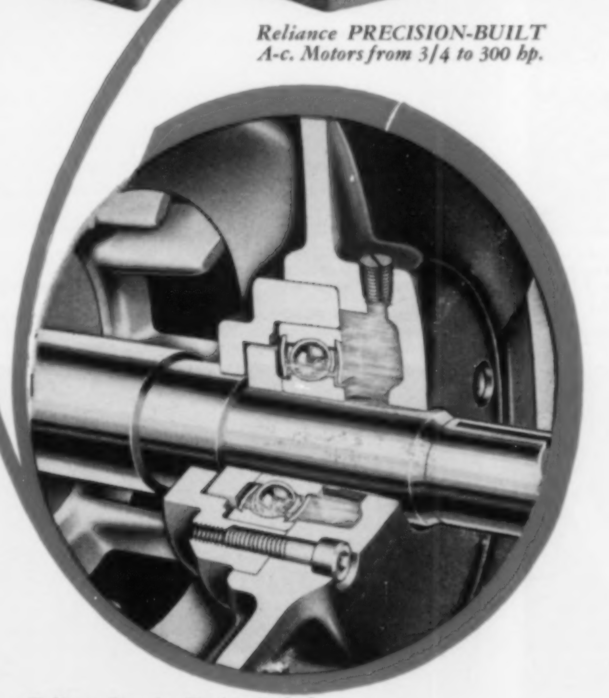
# PRE-LUBRICATED BEARING DESIGN

## in

# RELIANCE MOTORS

*Reliance PRECISION-BUILT A-c. Motors from 3/4 to 300 hp.*

## *provides more operating hours without re-lubrication!*



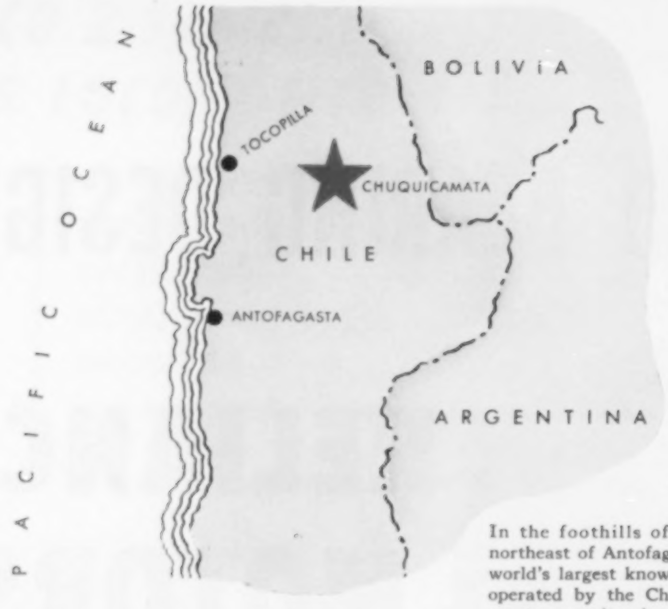
*Reliance Bearing Design, including extra-large grease reservoir, provides longer bearing life.*

Original, factory lubrication permits more operating hours without re-lubrication than that of any other pre-lubricated bearing. From a larger grease reservoir than provided with any standard bearing, Reliance double-shielded bearings automatically take on new grease as needed. And the Reliance design not only *keeps* bearings lubricated, but makes it *impossible to overgrease* a Reliance Motor. Get the convenient chart on which you can check these and other features which combine to give you 15 important advantages in the Reliance Pre-lubricated Bearing Design . . . write today for Bulletin B-2201.

RELIANCE
*Precision-Built*
MOTORS

**RELIANCE ELECTRIC AND ENGINEERING CO.**

**1057 Ivanhoe Road, Cleveland 10, Ohio • *Sales Representatives in Principal Cities***

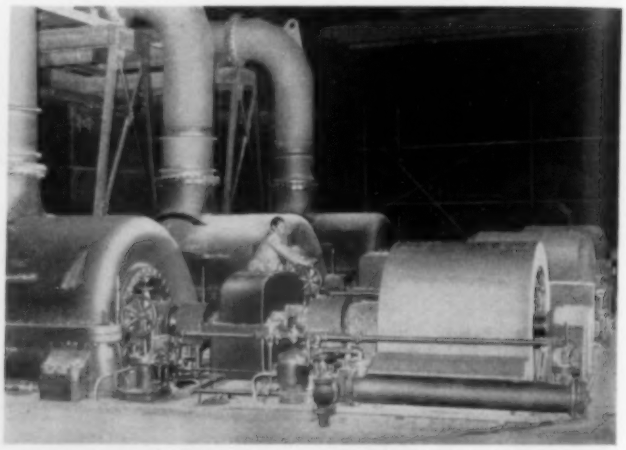


*another milestone of*

# New sulphide
# to boost

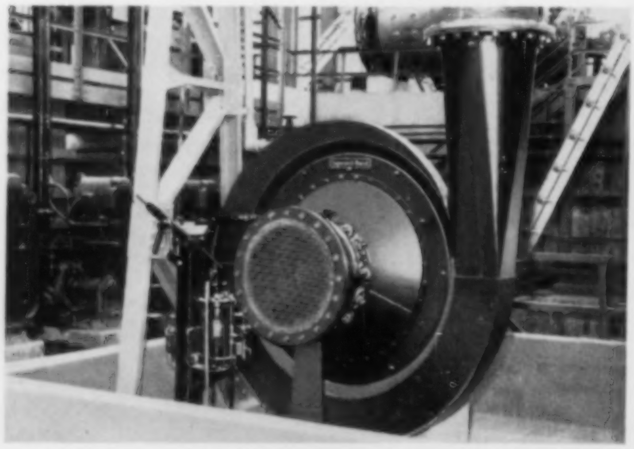
In the foothills of the Andes, about 150 miles northeast of Antofagasta, at Chuquicamata, lies the world's largest known copper ore body. Owned and operated by the Chile Exploration Company, this great open-pit mine since its start of operation in 1915 has produced over 10 billion pounds of copper.

**CONSTRUCTION EQUIPMENT** – Where there's construction, there's rock to be removed. And at "Chuqui," Ingersoll-Rand Wagon drills and Jackhamers played a major role in the excavating. I-R portable compressors furnished air power for the drills.

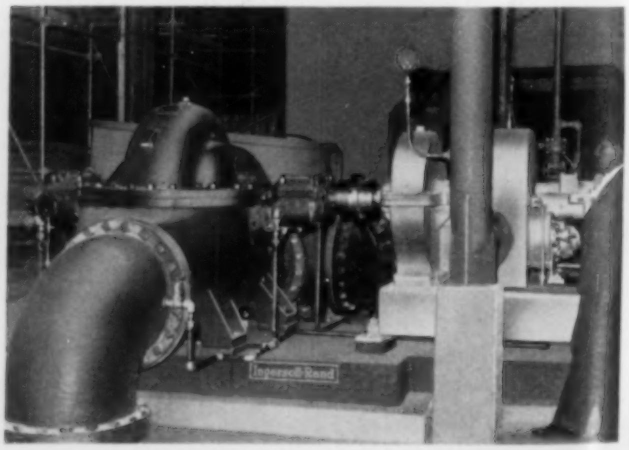


**CONVERTER BLOWERS** – Three of the four Ingersoll-Rand 30,000 cfm, 15 lb. copper converter multi-stage Turbo Blowers which will serve the smelter at the new Chuquicamata Sulphide Plant.

**FLOTATION BLOWERS** – One of the five Ingersoll-Rand Type FS Turbo blowers that will serve the flotation plant.



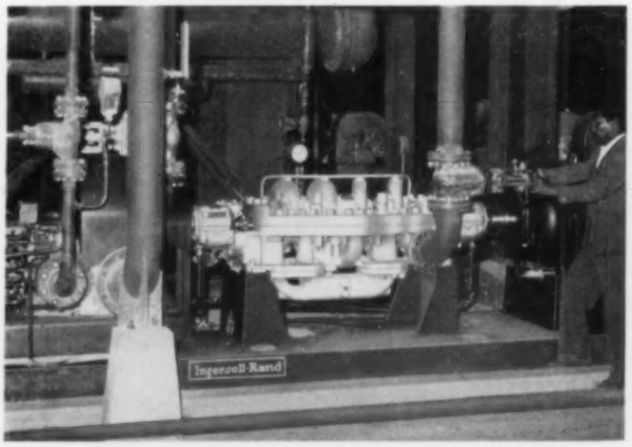
**CIRCULATION PUMPS** – A 20-inch Ingersoll-Rand Class LFV Condenser circulating pump. Three additional identical units are also installed. Each pump is rated at 10850 gpm.



COMPRESSORS · AIR TOOLS · ROCK DRILLS · TURBO BLOWERS · PUMPS · CONDENSERS *progress at Chuquicamata...*

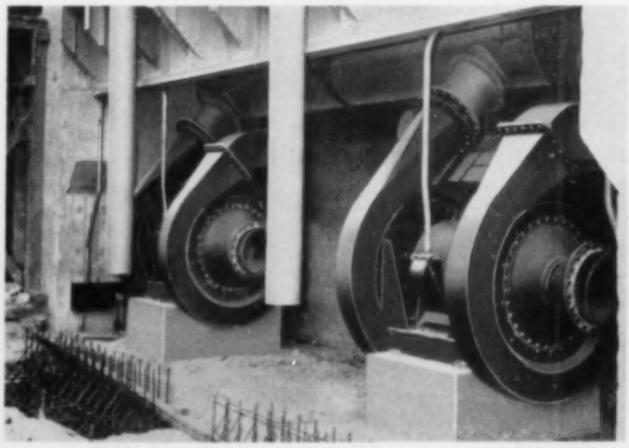
# ore-processing plant output of strategic copper

## *Ingersoll-Rand equipment used both in the construction and the operation of Chile Exploration Company's new plant.*



**BOILER-FEED PUMPS** — Feed water for the boilers at this new installation will be handled by four I-R Class RT 8-stage pumps. Each pump is rated at 167 gpm and 575 psi.

**REVERBERATORY BLOWERS** — Eight FS Turbo blowers like these pictured here will serve the Reverberatory furnace oil burner. The casting furnace will use four additional FS blowers.



Strategic copper will get a big boost in production in early 1953 when the Chile Exploration Company's new copper sulphide plant at Chuquicamata goes into full operation. This new modern plant was designed to increase the present Chuquicamata output to more than 500,000,000 pounds of copper per year.

New crushing plants, a concentrator and a smelter are among the principal structures being erected, not to mention a large-scale housing development and a new sewage disposal plant.

Ingersoll-Rand compressors, wagon drills, Jackhamers and other tools have been used extensively in the construction of these new facilities. And I-R blowers, compressors and pumps will be used in their operation.

But the name Ingersoll-Rand is not new in the Chuquicamata district. I-R equipment has been on the job at "Chuqui" since the start of operation there in 1915.

And in all parts of the world, wherever materials must be mined, you'll find Ingersoll-Rand.

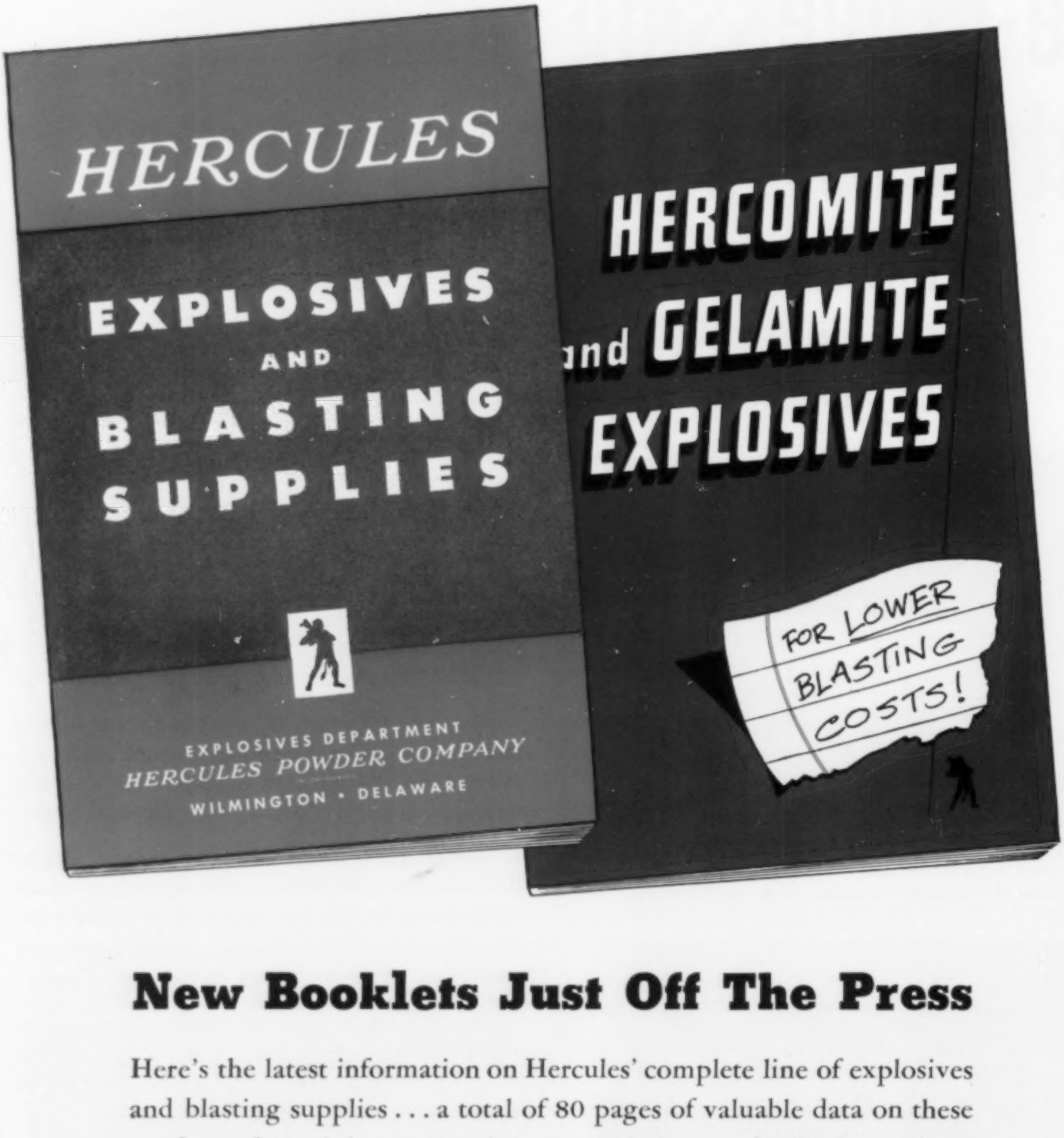
• DIESEL ENGINES

**Ingersoll-Rand**

11 Broadway, New York 4, N. Y.
Offices and Agents throughout the World

854—14

# Explosives Up-To-Date


HERCULES
EXPLOSIVES AND BLASTING SUPPLIES
EXPLOSIVES DEPARTMENT
HERCULES POWDER COMPANY
WILMINGTON · DELAWARE
HERCOMITE and GELAMITE EXPLOSIVES
FOR LOWER BLASTING COSTS!

## New Booklets Just Off The Press

Here's the latest information on Hercules' complete line of explosives and blasting supplies . . . a total of 80 pages of valuable data on these products for mining, quarrying, construction, and seismic exploration. If you use explosives in any way, these two new booklets are a "must" for your engineering and purchasing departments. Write for free copies to:

*Explosives Department*
**HERCULES POWDER COMPANY**
INCORPORATED
*932 King Street, Wilmington 99, Delaware*

XR53-1

# Give Your Ejection Problems the Air

## ...and boost production and safety

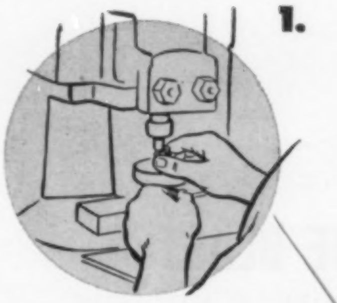
❶ End slow, dangerous hand removal of work with a Schrader Air Ejection Set. Install Schrader Air Ejection Sets on your power presses—or any machines with moving parts to actuate a cam or sliding tripper. You'll find production soars—up to 100% ... operator safety is boosted 50%. Replace hand removal with Schrader Air Ejection and watch your presses take a new lease on life.

❷ Replace wasteful, homemade steady air blasts with Schrader Air Ejection Sets. Air costs drop as much as 90% because Schrader Air Ejection Sets ration out *just enough* air to do the job ... synchronize your air blast with demand. Before you decide your old compressors have reached full capacity, check with Schrader to see how to cut air waste.

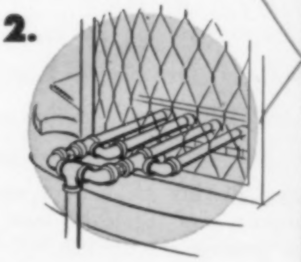
**Schrader Air Ejection Sets** are delivered fully assembled and ready to go to work. Their low cost is more than repaid in just a few weeks.

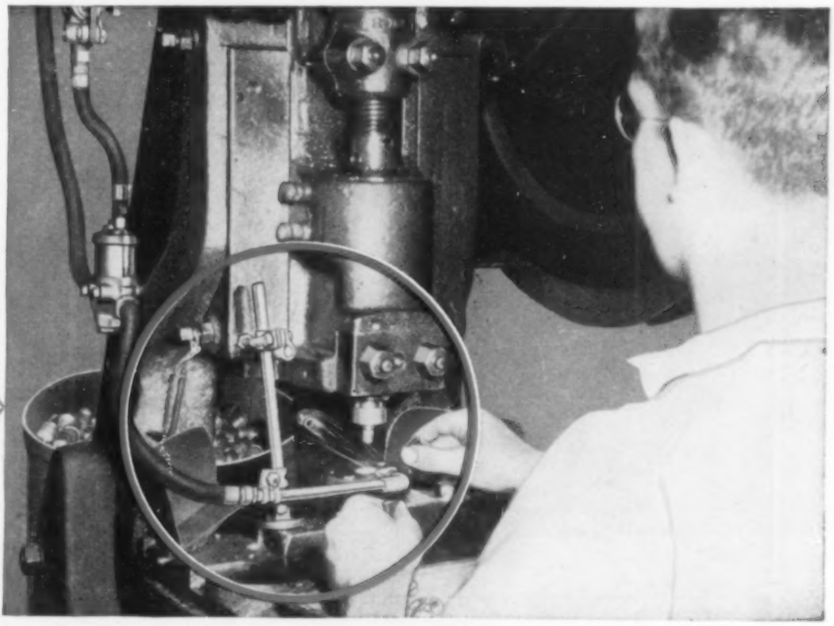
See how Schrader Air Ejection Sets will help you plan more effective use of machines. Write, describing the machines on which their use is contemplated—or fill out the coupon below.

1.



2.





**Schrader**

REG. U. S. PAT. OFF.

**products control the air**

**Mail This Coupon Today**

**A. SCHRADER'S SON**
*Division of Scovill Manufacturing Company, Incorporated*
**478 Vanderbilt Avenue, Brooklyn 17, N. Y., Dept. W-2**

I am interested in more information on ..........................................

Name ______________________ Title ______________

Company ______________________

Address ______________________ ______________________

**Air Cylinders • Operating Valves • Press & Shear Controls • Air Ejection Sets • Blow Guns • Air Line Couplers • Air Hose & Fittings • Hose Reels • Pressure Regulators & Oilers • Air Strainers • Hydraulic Gauges • Uniflare Tube Fittings**

*teamwork*
*in*
*specialties*

# THE BLASTER

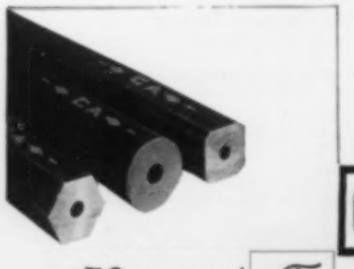
*CRUCIBLE HOLLOW DRILL RODS*

In rock-drilling operations, the blaster is a key man. He plans the blast, tells the drill-runners where to drill their holes, loads the charge for the greatest effectiveness.

He expects . . . and gets . . . peak efficiency from his men and the tools they use.

This is why Crucible Hollow Drill Rods rank first with crews supervised by top-notch blasters. Experience has shown them that Crucible rods stand the rapid-fire battering of modern rock-drilling longer; give them the least breakage, the greatest service life.

Crucible Hollow Drill Rods are right for the job because they are made by the world's largest producer of *tool and high speed steels.* From this metallurgical experience come the high mechanical properties that have set record after record for least cost per foot drilled. Use Crucible Hollow Drill Rods in all your drilling operations.



**CRUCIBLE** first name in special purpose steels

52 *years of* *Fine* *steelmaking*

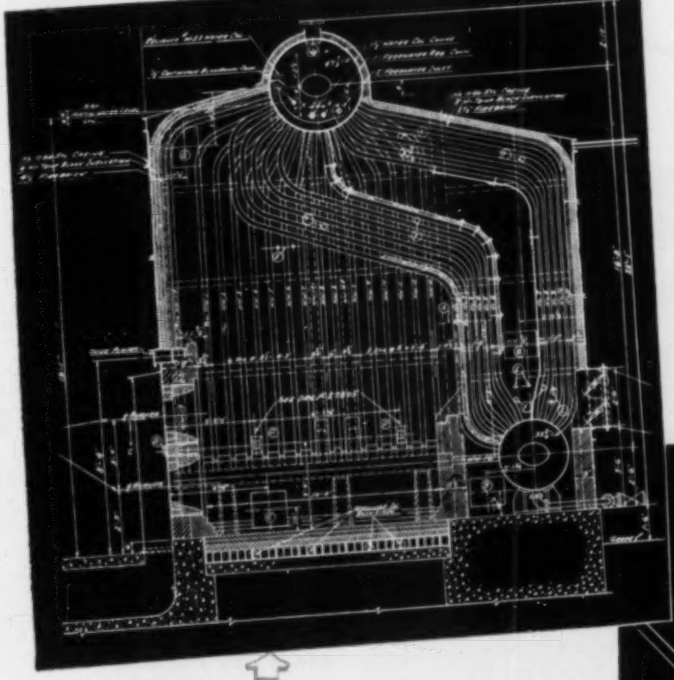
## HOLLOW DRILL RODS

CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

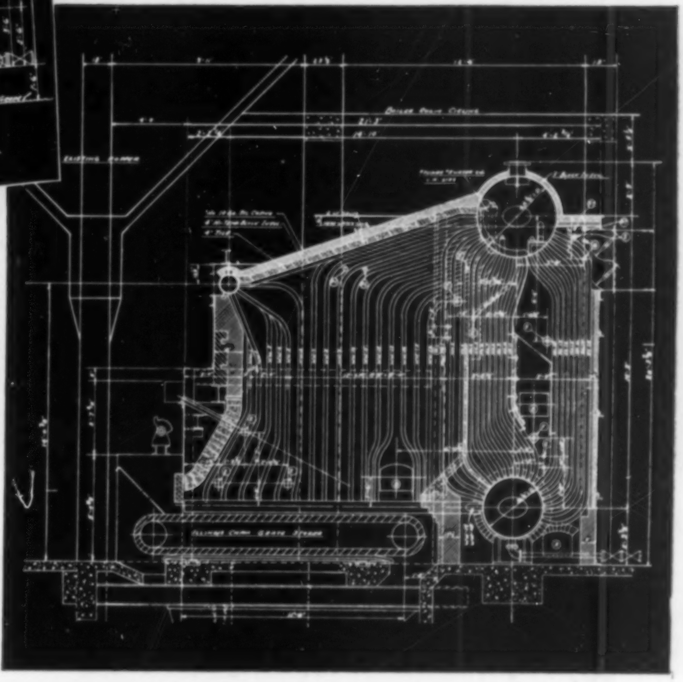
REX HIGH SPEED • TOOL • REZISTAL STAINLESS • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS

# Industry Approved

## *Two-Drum* STEAM GENERATORS by Vogt



**CLASS VF**
A 22,000 pounds steam per hour unit installed at Indiana Farm Bureau Refinery, Mt. Vernon, Ind.



**CLASS VS**
The Seelbach Hotel, Louisville, Ky. is served by this 30,000 pounds steam per hour boiler.

A wide variety of industrial plants and other users of steam for power, processing, or heating have found these efficient Vogt Two-Drum Type Boilers to be the answer to their diverse steam generating requirements.

Class VF units provide maximum capacity in limited floor space and head room, while Class VS is best adapted to installations not having such restrictions. Each has a large furnace volume and a high ratio of radiant heating surface. The furnace design assures proper combustion of fuels fired in suspension or with various type of stokers.

*A bulletin with general information and showing typical installations is available on request.*

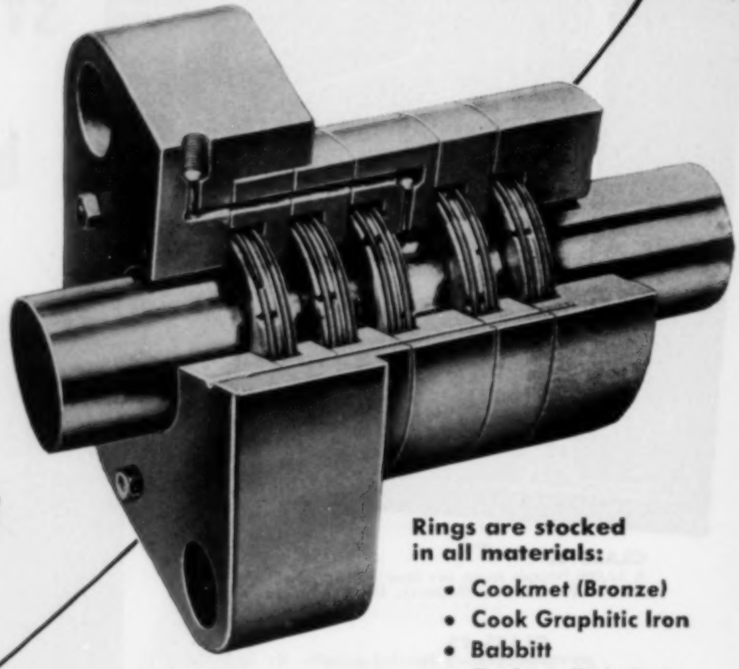
## Typical Users...

**FOOD PROCESSING PLANTS**
**DISTILLERIES • HOTELS**
**HOSPITALS • CHEMICAL PLANTS**
**PETROLEUM REFINERIES**

**HENRY VOGT MACHINE CO., Louisville 10, Kentucky**
BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

# FAST SERVICE

***Your order for COOK packings and replacement parts gets priority attention!***



**Rings are stocked in all materials:**
- **Cookmet (Bronze)**
- **Cook Graphitic Iron**
- **Babbitt**
- **Cookroc (Bakelite)**

THERE'S NO NEED to lose valuable production time waiting for the arrival of packing replacement parts. Cook's warehouses and branch offices are strategically located throughout the country and are geared to give you the fastest possible service in meeting your requirements. In fact, our set-up enables us to make emergency shipments of most standard sizes of Cook Graphitic Iron, Babbitt, Cookmet (bronze) or Cookroc (bakelite) packing rings immediately on receipt of your order.

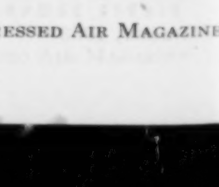
And, if you're running into unusual operating troubles, remember that we have a nationwide organization of experienced field engineers ready to work with you in recommending a solution to your problems.

So, next time you need replacements - call COOK - the name that's synonymous with better packing service the world over.

C. Lee Cook Mfg. Co., Incorporated, Louisville, Ky. Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

## COOK

ROD PACKINGS



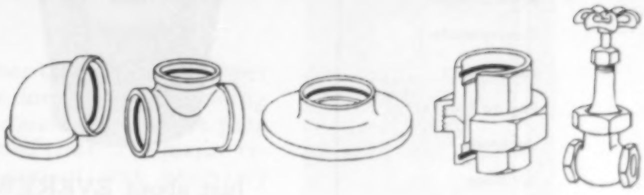
. . SEALING PRESSURES SINCE 1888 . . .

# WALSEAL®

## COMPLETE LINES OF WALSEAL VALVES AND FITTINGS

WALSEAL is a smooth-bore, bronze valve or pipe fitting having a **factory-inserted** ring of silver brazing alloy in the outlet or outlets. The brazed joint that results when a Walseal product is installed is leakproof, vibration-proof, and corrosion resistant. The alloy fillet that appears upon completion of the joint is visual assurance of **full penetration of alloy.** This improved method of joining brass, copper, or copper-nickel pipe or tube is another Walworth contribution to the progress of the valve and fittings industries.

In addition to its complete line of Walseal products, the Walworth Company manufactures complete lines of valves, fittings, unions, and flanges in a wide range of sizes and temperature-pressure ratings. The company also makes three lines of pipe wrenches, the Genuine Stillson, Walco, and Parmelee. Walworth products total approximately 50,000 items and are sold through distributors or agents in all parts of the world.



The sectioned Walseal tee illustrated, shows: (a) the fillet of alloy that appears upon completion of the Walseal joint. This fillet is your visual assurance of complete penetration. (b) the factory-inserted ring of silver brazing alloy. (c) sectioned view of the completed Walseal joint showing penetration of alloy both ways from the insert. Walseal joints can be made only with Walseal valves or fittings. For further details regarding Walseal products, ask for Circular 84.

**WALWORTH**

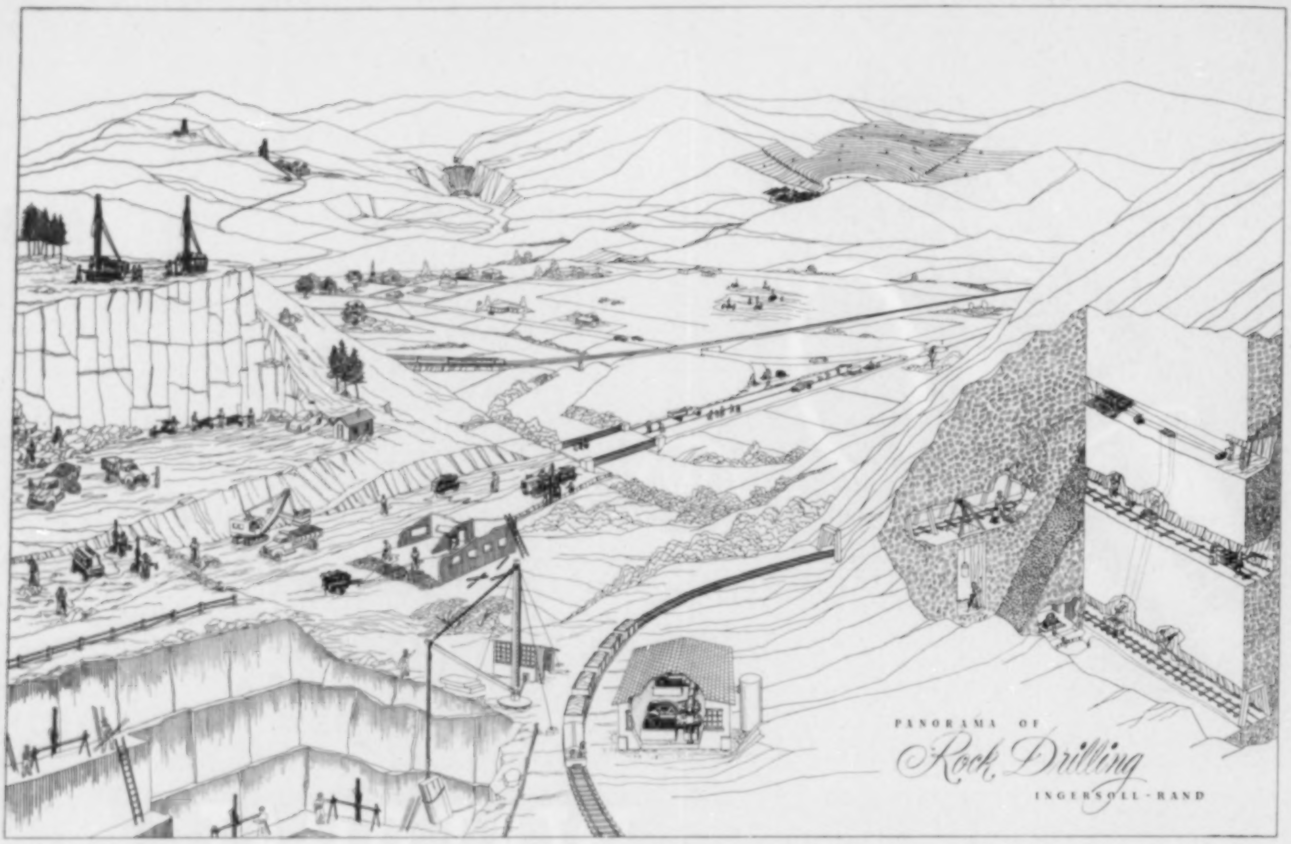
*Manufacturers since 1842*

**valves . . . fittings . . . pipe wrenches**

60 East 42nd Street, New York 17, N. Y.

SEE OUR CATALOG IN SWEET'S

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD



Enlarged prints of this interesting and instructive drawing are available free of charge for schools, colleges and field offices. Write for a copy today.

**INGERSOLL-RAND PRODUCTS**

- Carset Jackbits
- Drifters
- Stopehamers
- Wagon Drills
- Jackdrills
- Boom Jumbos
- Quarrymasters
- Jackhamers
- Paving Breakers
- Jackrods
- Air Hose
- Air-Line Lubricators
- Hose Couplings
- Jackrod Furnaces
- Drill Steel Furnaces
- Sharpeners
- Jackbit Grinders
- Shank Grinders
- Cut-off Machines
- Slusher Hoists
- Air Tools
- Pumps
- Portable Compressors
- Stationary Compressors
- Diesel Engines

*No matter what you need for drilling rock,*

**IT'S INGERSOLL-RAND**

**EVERY BIT OF THE WAY!**

Where does I-R fit into the rock drilling picture? Just about EVERYWHERE—as you can see from the above drawing in which the artist has included practically every rock drilling application.

But there's more here than meets the eye. For Ingersoll-Rand can supply everything from the Carset Jackbit all the way back to the compressor. From one source with undivided responsibility, you get a coordinated line of equipment that's designed to work together with maximum efficiency. You get complete service, too—backed by 80 years of experience and leadership in this specialized field.

Make Ingersoll-Rand your headquarters for everything in rock drilling.

IR

**Ingersoll-Rand**
11 Broadway, New York 4, N. Y.

838-5

ROCK DRILLS • COMPRESSORS • AIR TOOLS • CENTRIFUGAL PUMPS • TURBO BLOWERS • CONDENSERS • DIESELS • GAS ENGINES

# TOLEDO THREADER

## *Keeps 'em drilling*

## in Arizona's Largest Zinc Mine!

**23,000 DRILL RODS turned, faced and threaded in 8 years by this TOLEDO —before any major service needed!**

The Iron King Mine is Arizona's largest producer of zinc and also an important producer of lead, gold and silver. All drilling is done with tungsten carbide detachable bits and alloy steel drill rods.

In 1944 a Toledo high speed threader was purchased. At that time, about 30,000 feet of blasting holes was drilled monthly, and about 10,000 bits passed through the shop for reconditioning.

For five years following the purchase of the Toledo Threader an average of 350 pieces of carbon steel per month were turned, faced and threaded on this machine. After changing to alloy rods and tungsten bits, the number dropped to 135 per month, but the duty of reconditioning this steel was much more severe than with carbon steel rods. No major repair or replacement was necessary until late in 1951, after more than 23,000 pieces of steel drill had been processed by this machine.

*You, too, can save time and reduce costs* with a TOLEDO Rock Drill Rod Machine! After rod is annealed, the Toledo Machine will turn to size, thread and face off end of rod to a perfect fit for detachable bits. Rugged ... simple... dependable. Send for bulletin 45. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office: 165 Broadway, Room 1310.

**"We are entirely satisfied with outstanding performance and service the TOLEDO Threader has given us," says H. F. Mills, General Mgr. of The Iron King Mine at Humboldt, Arizona.**

**RELY ON THE LEADER TOLEDO FOR ROCK DRILL ROD MACHINES**

# Hard-rock tunnels unlock reserves of Pennsylvania Anthracite

Tunnels driven deep into the mountains of Eastern Pennsylvania don't often make headlines because most of these bores are a familiar phase of long-range programs for opening up anthracite reserves well in advance of mining operations.

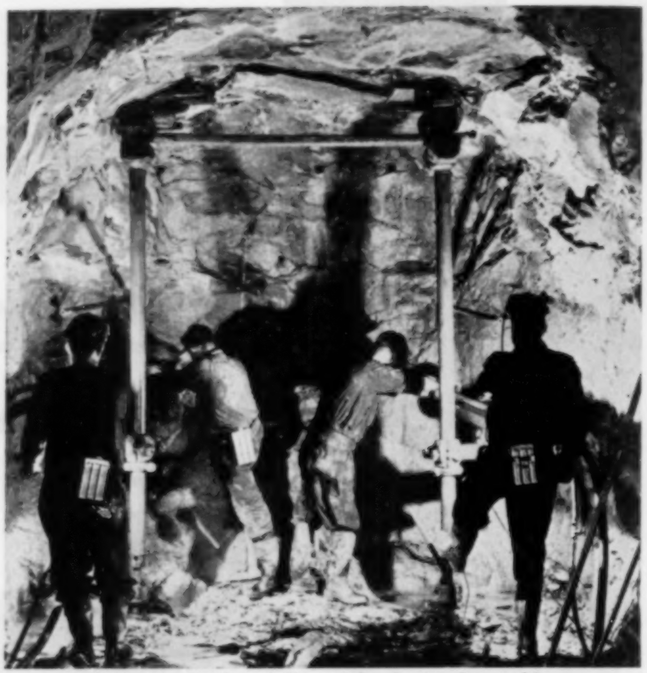
Galen H. Messner, an independent contractor, has been identified with hard-rock jobs in the anthracite region for more than thirty years. He specializes in development tunnels, slopes, and shafts. Some of his contracts call for driving steep rock holes for use as loading chutes and for ventilation; other jobs involve haulageways several miles long.

One of his current contracts is the driving of a cross-section tunnel at the Glen Burn Colliery, Shamokin, Pa. This type of tunnel, usually about 1200 ft long with a one-half per cent grade, is driven at right angles to a haulageway and cuts through the anthracite veins which occur here in narrow, steeply pitched seams.

In drilling a typical round, hand-cranked drifters on column mountings bore 8-ft holes through sandstone, shale, and hard conglomerate, using Bethlehem hollow drill steel fitted with detachable bits. Loaded by a two-drum air hoist, muck is hauled by mules—yes, real live mules!—to the nearest haulageway.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

*On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation*



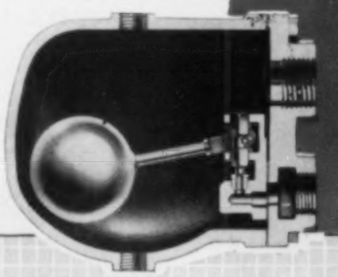
Bethlehem hollow drill steel fitted with detachable bits bores 8-ft holes into abrasive sandstone at the heading of this cross-section tunnel, about 7 ft high and 10 ft wide, at Glen Burn Colliery.

Galen H. Messner, veteran Shamokin contractor, has driven more tunnels than he can remember. He operates his own shops for reconditioning bits and rods. About Bethlehem hollow drill steel, he offered this terse comment: "Well, I've been using it exclusively for better than twenty years. What more can I say?"

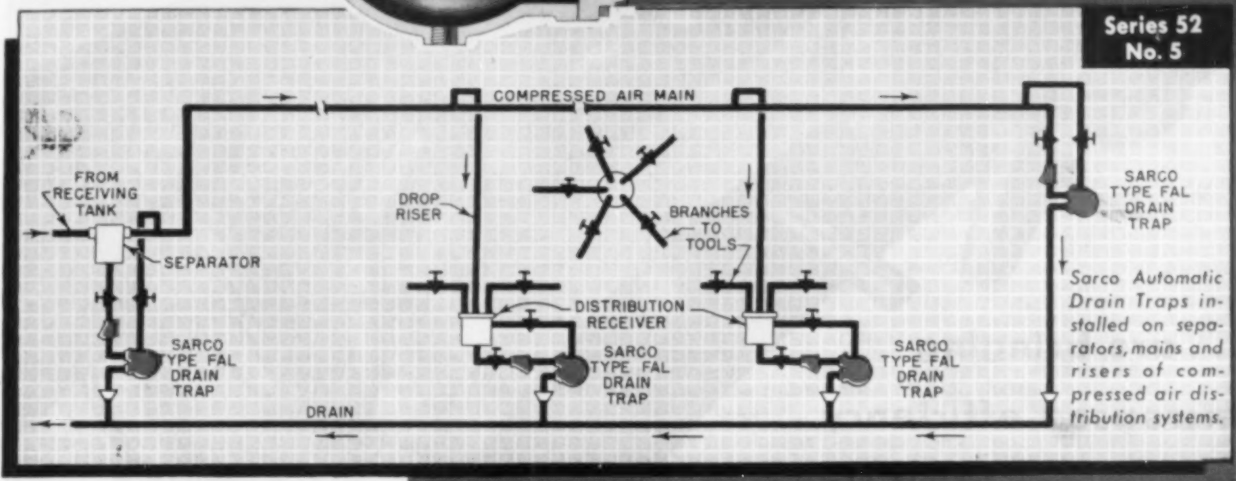
Glen Burn Colliery at Shamokin, Pa., is operated by Susquehanna Collieries Division of M. A. Hanna Co. This mine has produced high-grade anthracite for 100 years.

**BETHLEHEM HOLLOW DRILL STEEL**

Sarco Drain Trap type FA, sizes ¾" and 1", pressures to 750 psi. Floats, valve seats and discs are of stainless steel.



# REMOVE WATER


Series 52
No. 5
COMPRESSED AIR MAIN
FROM RECEIVING TANK
SEPARATOR
DROP RISER
BRANCHES TO TOOLS
DISTRIBUTION RECEIVER
SARCO TYPE FAL DRAIN TRAP
SARCO TYPE FAL DRAIN TRAP
SARCO TYPE FAL DRAIN TRAP
SARCO TYPE FAL DRAIN TRAP
DRAIN

*Sarco Automatic Drain Traps installed on separators, mains and risers of compressed air distribution systems.*

# ...from compressed air

## with SARCO automatic drain traps

Moisture condensing from compressed air in mains and distribution lines must be removed as soon as it collects. Otherwise there will be damage to tools, marred paint surfaces, or wetting of material to be cleaned, especially electrical machines and sand molds.

Water accumulating at the base of risers or low points in the lines may also cause water-hammer and trouble from freezing.

Sarco Drain Traps should be installed at the aftercooler, on separators, at the receiver and on low points in the lines, to remove water as quickly as it collects.

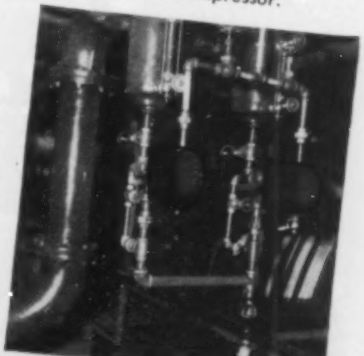
At nominal cost, these traps will greatly improve your compressed air operation.

Sarco Company, Inc., Empire State Bldg., New York 1, N.Y. Represented in principal cities. Sarco Canada Ltd., Toronto 8, Ont.

Sarco type FA Drain Trap removing separated water from aftercooler of air compressor.

IS YOUR AIR COMPRESSOR CAPACITY Effective?

TECHNICAL BULLETIN NO. 5-CA *will help you get more work from your air compressors at less cost. Write for your copy.*



Sarco automatic Drain Traps, type FA, removing water from compressed air separators.

**SARCO** saves steam

improves product quality and output

413

More and More Longer Lasting **Norbide*** **Nozzles...**

**... are bringing increased efficiency to pressure blast cleaning**

Molded from "the hardest material made by man" Norbide Nozzles outwear conventional cast iron nozzles hundreds of times . . . their orifices do not readily enlarge and thus the stream of sand or shot remains concentrated . . air pressure does not drop.

*Write for free bulletin #543 to:*

**Norton Company**

**Worcester 6, Massachusetts**

*Reg. trade-mark

### ON THE COVER

OUR cover picture shows a diving bell for use in rescuing crewmen from a sunken submarine, as described in the article that starts on page 17. Large enough to hold nine men, the bell serves as an elevator running between a rescue ship and the submarine.

To reveal its position, the stricken sub releases a buoy that rides at the end of a cable attached to one of the hatches. The rescue ship positions itself over the disabled craft, removes the buoy from its mooring cable and winds the cable on the drum of an air-operated winch within the diving bell. This pulls the bell down directly over the hatch, where it is firmly attached to the hull of the sub. The hatch is then opened and the crewmen climb into the bell and are hoisted to the surface by reversing the air motor. Trips are made until all aboard have been saved.

•

### CORRECTION

INADVERTENT use of a "b" instead of an "m" caused a regrettable error in the article *Big Tom Project Nearing Completion* in our December issue. In the second paragraph, page 339, it was stated that the Bureau of Reclamation has brought water to six billion acres of land. The Bureau has done a lot, but not that much. The word "billion" should have been "million."

•

### ANOTHER TUNNELING RECORD

IT is difficult to keep abreast of the doings of the record-smashing tunnelers of Morrison-Knudsen Company of Canada on the Alcan Project in British Columbia. In our December issue (page 346) we reported a new mark of 261 feet of advance in a week established at the "2600" heading of the 25-foot-diameter, 10-mile-long Tahtsa Lake-Kemano Tunnel during the six days ended on November 1. The heading referred to is at the western end of the bore and is one of four faces at which driving is being done.

This record stood for less than a month. In the week ending November 29, crews driving eastward from one of the two headings opened off an adit intersecting the tunnel at Horetzky Creek, near the mid point, pushed ahead 274 feet. This exceeds the previous record by 13 feet and represents a daily average advance of 45.7 feet.

Equipment used was identical with that described in the account of the previous record: Sixteen 3½-inch power-feed, aluminum-shell drills mounted on a conventional platform-type carriage.

# Compressed Air Magazine

COPYRIGHT 1953 BY COMPRESSED AIR MAGAZINE COMPANY

VOLUME 58 **January, 1953** NUMBER 1

G. W. MORRISON, *Publisher*
C. H. VIVIAN, *Editor* J. W. YOUNG, *Director of Advertising*
ANNA M. HOFFMANN, *Associate Editor* J. J. KATARBA, *Business Mgr.*
J. C. PIERCE, *Assistant Editor* FRANCIS HARTMAN, *Circulation Mgr.*
A. W. LOOMIS, *Assistant Editor* WILLIAM HEINS, *Foreign Circulation Mgr.*
D. Y. MARSHALL, Europe, 243 Upper Thames St., London, E. C. 4.
F. A. MCLEAN, Canada, New Birks Building, Montreal, Quebec.

## EDITORIAL CONTENTS

Growth of a Natural-gas System—*C. H. Vivian* ........ 2
Cadillac Tank Plant—*Stanley Bell* ........ 9
Forging Hammer of New Type ........ 12
Portable Compressors in Role of Stationary Units—*Richard R. Reinheimer* ........ 15
Guardian Angels of the Submarines—*W. N. Johnson* ........ 17
Poof—There Goes Rust! ........ 20
Improved Sealant for Porous Castings ........ 20
Editorials—Tradition is Strong—The Highway Problem ........ 21
This and That ........ 22
Samson the Safety Demonstrator ........ 23
Pneumatic Tide Generator ........ 24
Steel-strip Width Gauge ........ 24
Lightweight Aggregate of Exceptional Fineness ........ 25
Drives Twenty Nails a Minute ........ 25
Industrial Notes ........ 26
Quotes from Here and There ........ 30
Books and Industrial Literature ........ 32

## ADVERTISING CONTENTS

Bethlehem Steel Company ........ 16
Canadian Ingersoll-Rand Co., Ltd. 14
Cook Mfg. Co. Inc., C. Lee ........ 12
Coppus Engineering Corp. ........ 2nd Cover
Crucible Steel Co. of America ........ 10
Dollinger Corporation ........ 3
Eimco Corporation, The ........ 4, 28
Elliott Company ........ 27
Fluor Corporation, Ltd., The ........ 32
Galland-Henning Mfg. Co. ........ 30
Garlock Packing Company, The ........ 20
Goodall Rubber Company ........ 31
Hansen Mfg. Co., The ........ 29
Hercules Powder Company ........ 8
Ingersoll-Rand Company ........ 6, 7, 26, 3rd Cover
Logan Engineering Co. ........ 30
Naylor Pipe Company ........ 21
New Jersey Meter Company ........ 31
Niagara Blower Company ........ 22
Norton Company ........ 18
Reliance Electric & Engineering Co. ........ 5
Sarco Company, Inc. ........ 17
Sauerman Bros., Inc. ........ 19
Schraders' Sons, A. ........ 9
Square D Company ........ 30
Texas Company, The ... Back Cover
Timken Roller Bearing Co., The ........ 25
Toledo Pipe Threading Machine Co. ........ 15
Victaulic Co. of America ........ 23
Vogt Machine Co., Henry ........ 11
Walworth Company ........ 13
Wisconsin Motor Corporation ........ 24

**A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.**

CCA Member Controlled Circulation Audit

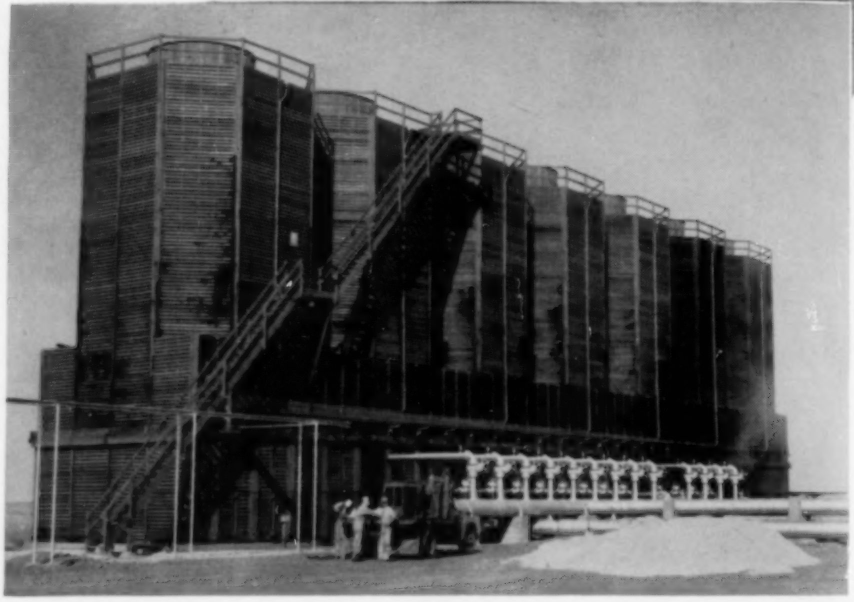
Published by Compressed Air Magazine Co., G. W. MORRISON, *President;*
C. H. VIVIAN, *Vice-President;* A. W. LOOMIS, *Vice-President;*
J. W. YOUNG, *Secretary-Treasurer.*
Editorial, advertising, and publication offices, Phillipsburg, N. J.
New York City Office, 11 Broadway. L. H. GEYER, *Representative.*
Annual subscription: U.S., $3.00, foreign, $3.50. Single copies, 35 cents.
COMPRESSED AIR MAGAZINE is on file in many libraries and is indexed in Industrial Arts Index and in Engineering Index.

# Growth of a Natural-Gas System

## Northern Natural Company, Serving Parts of Five States, Continues to Expand Facilities

**C. H. Vivian**

COMPRESSOR BUILDING
The chimneylike structures are mufflers on the exhausts of the gas engines that drive the compressors. Near the ground beside each muffler is the slatted combustion-air intake for each machine. Within each housing is an Air-Maze curtain-type filter that automatically cleans itself by continually passing through an oil bath.



COOLING TOWER
This Fluor 7-cell, induced-draft wooden tower is the largest one in the Northern Natural system. Its function is to cool water which, in turn, cools the engine and compressor cylinders.

### Nation's Distribution Network Doubling Every Ten Years

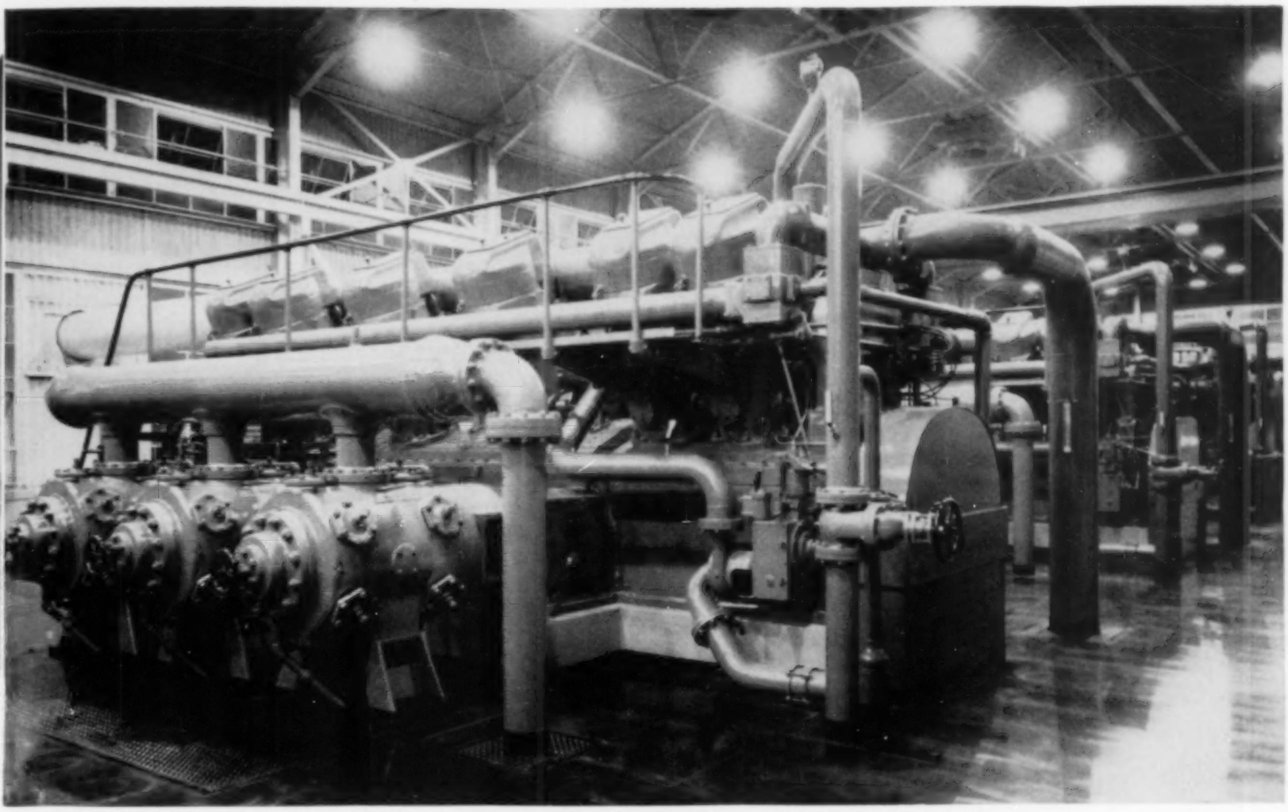
THE natural gas that is piped throughout the nation supplies five times as much energy as all our electric generating plants. Transmitting gas in that way is not a modern idea, for more than 2800 years ago the Chinese piped the fuel through hollowed-out bamboo to vats in which they produced salt by evaporating brine. The first American line was a few miles long and conveyed gas under low pressure in 1821 for lighting the streets of Fredonia, N. Y. Just 70 years later the first high-pressure line was laid between Greentown, Ind., and Chicago, Ill., a distance of 120 miles. It was designed to operate at 600 psi and actually reached 525. Previously the gas had been shipped into the city in cylinders under 700 psi.

The modern era of gas transportation began about a quarter-century ago with the discovery of extensive fields in the Southwest, notably the Monroe in Louisiana, the Panhandle in Texas, and the Hugoton in Texas, Oklahoma and Kansas. During the decade starting in the mid-twenties, the mileage of lines doubled, and then it doubled again between 1935 and 1945. And by 1955, if the present trend continues, it will double once more—represent an 8-fold growth in 30 years, to say nothing of the increases in pipe sizes and carrying capacity.

Originally, the field pressure of the gas was sufficient, or nearly so, to move it to its destination. As the demand for the fuel increased and lines were lengthened, it became necessary not only to lay larger-diameter pipe but also to restore the lagging pressure in the lines by stationing compressors at intermediate points. The pioneer compressor on a natural-gas line is believed to have been installed at Rixford, Pa., and was a steam-driven machine of 26-inch stroke. It pumped six million cubic feet a day from Rixford to Bradford through a cast-iron pipe 11 inches in diameter. Line friction is such that, to maintain the terminal pressure in a modern high-pressure system, it is necessary to space the compressors at regular intervals along the line.

Pipelining is as truly a form of transportation as is railroading, but there are marked and obvious differences between them. In the former, only the gas flows; the "pushers," which are the compressors, remain stationary, unlike locomotives. Furthermore, movement of gas is continuous. Supply and delivery are never intermittent, as in the case of rail or water transportation.

To the uninitiated, it might seem that little weight is handled when dealing with a substance as light as natural gas, which is only about two-thirds as heavy as air. Actually, however, a line such as the Northern Natural, which delivers a peak of 675 million cubic feet daily, handles 16,200 tons of "freight," which is equal to the load carried by a 480-car train. It is the job of the compressors to keep the gas moving. To operate them, a total of 248,800 hp. is brought to bear. This is equivalent to the power in 62 large freight locomotives. It should be noted, also, that the compressors on such a system run months at a stretch, whereas even new, highly dependable diesel locomotives are normally rested and serviced at least once every 24 hours.



**LUNGS OF A PIPE LINE**

One end of a row of ten Ingersoll-Rand 1320-hp compressors in the Hugoton gathering station in southwestern Kansas. Gas from approximately 400 wells is piped in and boosted in pressure to send it along to the main line that extends northward some 800 miles. Fuel for operating the machines comes from the same source. Each unit has a 12-cylinder V-type gas engine driving three horizontal compressor cylinders. In this building is the largest block of compressor power (13,200 hp) ever put in service at one time by Northern Natural Gas Company.

OUR fast-growing natural-gas industry is sweeping on to new high marks. At the end of July it had 18.1 million customers, or more than 70 percent of all gas consumers in the country. Their ranks were increased by 2½ million in the preceding year mainly because of conversions from manufactured to natural gas in New York and New England. Natural-gas sales for the 12-month period aggregated 46,612 million therms (a therm is equal to 100,000 Btu's) and yielded $1810 million in revenue.

In the five years prior to 1952, natural-gas companies spent in excess of five billion dollars to expand their facilities, and a like sum is earmarked for the purpose during the five years of 1952-56. In contrast, only 10 percent as much, or $500 million, is slated for expenditure during the same interval to step up production and distribution of manufactured gas. The natural-gas companies had expected to lay out $1.19 billions in 1952 alone, but probably will not reach that figure because of materials shortages brought about by the strike in the steel industry.

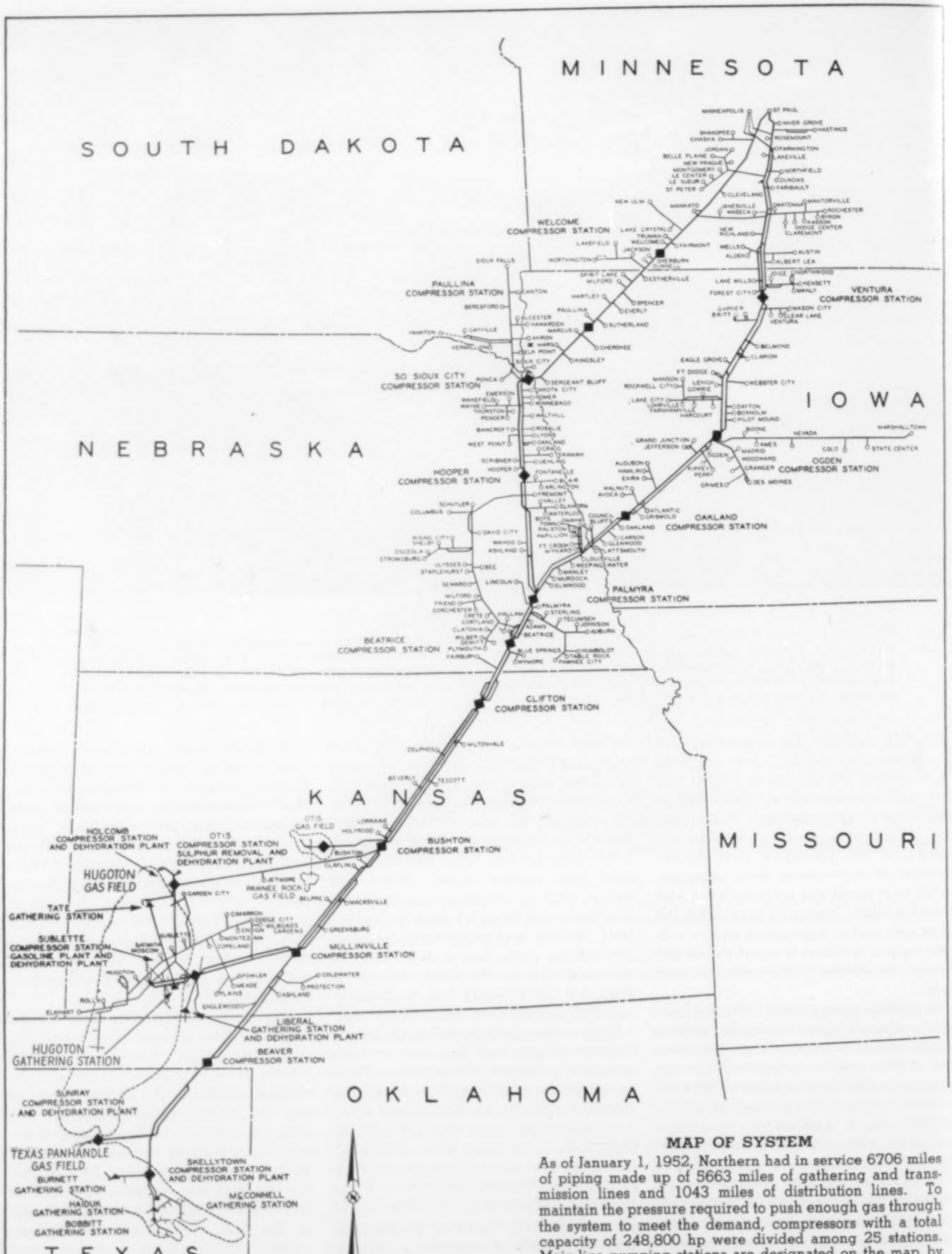
Postwar expansion has included both construction of new transmission lines from the major fields in the Southwest to markets in various parts of the country and increases in the capacities of existing distribution systems. In some instances, the growth of established carriers borders on the spectacular. Take, for example, the case of the Northern Natural Gas Company. This relatively "old" concern has been operating for more than twenty years. When laid out in 1929 to transport gas from the Panhandle and Hugoton fields to Omaha, Neb., its line was designed to transmit 215 million cubic feet a day. Service was extended to St. Paul, Minn., in 1933, but the capacity had mounted to only 243 million cubic feet daily by 1945.

Then came a pronounced spurt in the demand for gas that has not yet been completely satisfied. From 1945 to 1948, expenditures of $40 million raised the system's capacity to 425 million cubic feet daily. But that was not enough, and in the next three years additional outlays of $111,339,446 brought the daily capacity to 675 million cubic feet. From the end of World War II to the beginning of 1952 the value of the physical property (pipe lines, compressor stations, etc.) increased from $65 to $215 million.

As of the first of this year, Northern's network, totaling 6706 miles of pipe lines and 25 compressor stations, extended from sources of supply in Texas, Oklahoma and Kansas through Nebraska and Iowa to Minnesota and South Dakota. The company retails gas through its Peoples Natural Gas Division to about 50,000 customers in communities along its system, but wholesales most of its load to 27 utilities that resell it. All told, 637,993 consumers were served during 1951 in a territory having a population of 2,383,130. During the twelve-month ended June 1, 1952, sales amounted to 211.6 billion cubic feet (an average of 580 million a day), compared with 186.2 billion in the corresponding, preceding year.

Northern has plans to raise its delivery capacity to more than one billion cubic feet a day. The immediate objective is 825 million, which can be reached by adding 213 miles of pipe line and 100,160 compressor horsepower. On June 24, last, the Federal Power Commission authorized expenditures of $38 million towards this goal. In addition, the company has applied for permission to spend $11,692,000 to install 102 miles of line and 14,520 compressor horsepower. Originally, it contended that these facilities would not come under the jurisdiction of FPC, but the latter ruled otherwise.

Northern is taking steps to assure a plentiful future gas supply. For some years it has been acquiring control of


MINNESOTA
SOUTH DAKOTA
NEBRASKA
IOWA
KANSAS
MISSOURI
OKLAHOMA
TEXAS
WELCOME COMPRESSOR STATION
PAULLINA COMPRESSOR STATION
VENTURA COMPRESSOR STATION
SO SIOUX CITY COMPRESSOR STATION
OGDEN COMPRESSOR STATION
HOOPER COMPRESSOR STATION
OAKLAND COMPRESSOR STATION
PALMYRA COMPRESSOR STATION
BEATRICE COMPRESSOR STATION
CLIFTON COMPRESSOR STATION
HOLCOMB COMPRESSOR STATION AND DEHYDRATION PLANT
OTIS COMPRESSOR STATION SULPHUR REMOVAL AND DEHYDRATION PLANT
OTIS GAS FIELD
BUSHTON COMPRESSOR STATION
HUGOTON GAS FIELD
PAWNEE ROCK GAS FIELD
TATE GATHERING STATION
SUBLETTE COMPRESSOR STATION GASOLINE PLANT AND DEHYDRATION PLANT
MULLINVILLE COMPRESSOR STATION
LIBERAL GATHERING STATION AND DEHYDRATION PLANT
HUGOTON GATHERING STATION
BEAVER COMPRESSOR STATION
SUNRAY COMPRESSOR STATION AND DEHYDRATION PLANT
TEXAS PANHANDLE GAS FIELD
SKELLYTOWN COMPRESSOR STATION AND DEHYDRATION PLANT
BURNETT GATHERING STATION
HAIDUK GATHERING STATION
McCONNELL GATHERING STATION
BOBBITT GATHERING STATION
N

MAP OF SYSTEM

As of January 1, 1952, Northern had in service 6706 miles of piping made up of 5663 miles of gathering and transmission lines and 1043 miles of distribution lines. To maintain the pressure required to push enough gas through the system to meet the demand, compressors with a total capacity of 248,800 hp were divided among 25 stations. Main-line pumping stations are designated on the map by solid squares; gathering stations by solid triangles. Gas is obtained from two large fields and two smaller ones in Texas, Oklahoma and Kansas. The system serves 638,000 consumers in 230 communities in five states. The area is in the heart of "the breadbasket of the nation" and, in addition to engaging in diversified agriculture, has many large industrial plants that employ thousands of workers.

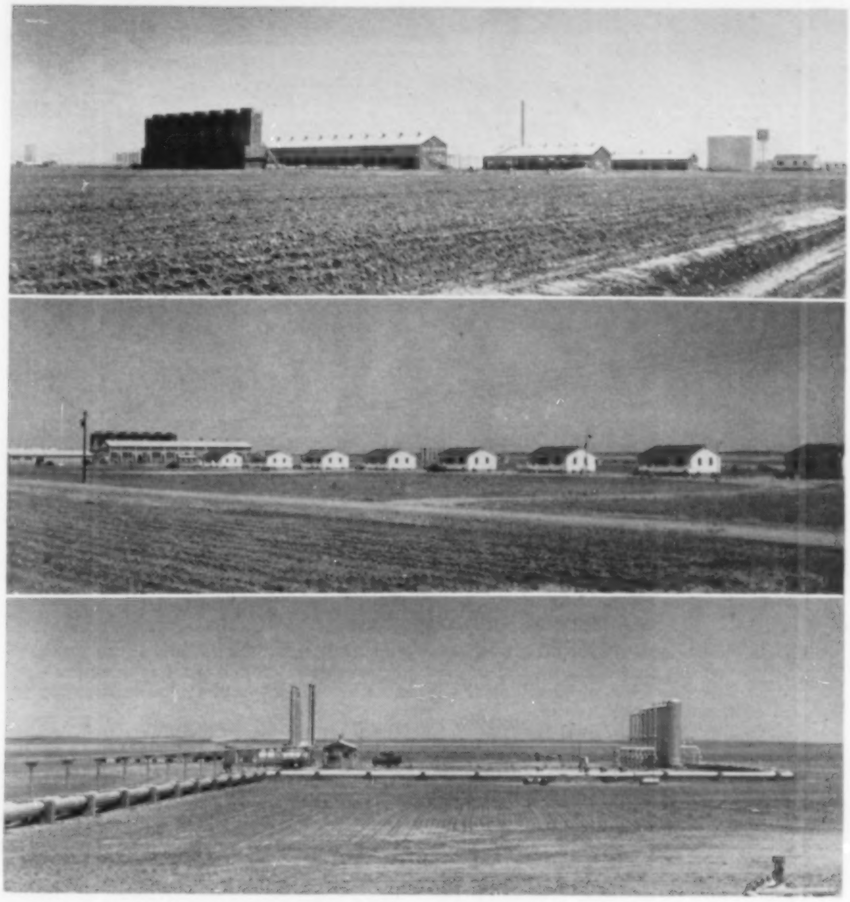
the gas underlying certain parts of the Hugoton and Panhandle fields. At the end of 1951 these reserves were estimated at 5.93 trillion cubic feet, of which 1.4 trillion was owned outright and the remainder covered by purchase contracts with the owners. During the last calendar year, one-fifth of the gas transmitted came from these resources, much of it from company-owned wells.

Realizing that it must look elsewhere for additional substantial sources of supply, Northern established a geology department and stationed representatives in North Dakota and the Canadian Province of Alberta, where important new oil and gas fields are under development. It has leases on acreage in the Williston Basin in North Dakota, in the Nebraska section of the Denver-Julesburg Basin and in the Andarko Basin. In the latter area it has drilled several dry holes, but is continuing exploration.

In September of this year Northern purchased 51 percent of the capital stock of the Permian Basin Pipe Line Company, which owns gas reserves in western Texas and southeastern New Mexico. Permian has applied to the Federal Power Commission for permission to build 105 miles of 26-inch line from the Sprayberry Field in Texas to Lea County, New Mexico, and 245 miles of 30-inch from there to a connection with Northern's system near Skellytown, Tex., at an estimated cost of $60 million. The carrier would have a daily capacity of 200 million cubic feet at the outset and 300 million in its second year.

Western Pipe Lines, organized in Canada, proposes to construct a 26-inch, 750-mile line from gas fields in southern Alberta due east to the city of Winnipeg. It would initially carry 250 million cubic feet a day. Northern has contracted to take at least 150 million cubic feet of this total at a point on the international border south of Winnipeg. From there it plans to lay 409 miles of 24-inch line to connect with the northern terminus of its present system near St. Paul and Minneapolis, Minn. The estimated cost would be $26 million. To bolster its condition even more, the company bought a small interest in the Husky Oil Company last July and will have first call on any gas developed by that concern or its Canadian subsidiary, which has already drilled some successful wells in Saskatchewan.

In connection with the movement to expand its sources of supply, Northern is also investigating the feasibility of storing gas underground near major market areas during the summer season so that it will be available for withdrawal in winter when the demand is high. Exploratory drilling to depths of 900 feet in the vicinity of St. Paul and Minneapolis was announced last August. Its purpose is to determine whether stratigraphic conditions there are favorable to the retention of gas under pressure.



**HUGOTON GATHERING STATION**

Rising from the flat Kansas prairie, the structures can be seen for miles. At the top is a general view showing, from left to right: dehydration plant, cooling tower, compressor building, auxiliary building, warehouse, water tanks, and office. In the center are pictured eight cottages erected for key operating personnel. At the bottom is a view of the dehydration equipment and the outgoing gas line extending to it from the compressor plant.

In 1951, Northern obtained 67 percent of its 203.8 million cubic feet of gas from the Hugoton Field, the largest known natural-gas repository. It was discovered in 1920, but its extent was not known for some years. The initial well, promoted by J. C. Mahoney of Liberal, Kans., A. M. White of Los Angeles, Calif., and W. B. Howard of Claremore, Okla., was drilled in search of oil on the John Boles farm 4½ miles west of Liberal. Starting in 1917 and using cable tools, the crew worked on and off for three years and finally struck gas at 3000 feet. Small importance was attached to the discovery, as gas was then in little use. The people of Liberal, a farmers' trading center since 1885, were burning wood and coal, and it was not until 1927 that gas was piped into the town.

A few far-seeing citizens realized the usefulness of the fuel and tried to win over the populace at large. Frank Boles, a brother of John and president of the Liberal Chamber of Commerce, together with Ray Millman, a liberal newspaperman who is still active on the editorial staff of the *Southwest Daily Times*, conceived the idea of piping the gas into the air and lighting it to demonstrate its heating and illuminating properties. They obtained a piece of pipe, attached it to the wellhead and succeeded in getting around 300 persons out to view the show. It was a still day, which is very unusual in that section of Kansas, and considerable gas leaked out when the valve was opened and settled near the ground. When a match was applied there was a big flare-up. No one was seriously injured, but the crowd left the scene so hurriedly that it went right through a barbed-wire fence.

A second well was brought in near the town of Hugoton in Stevens County in 1927, but still there was no boom. The Argus Production Company, of New York, sought to create markets for the fuel and drilled 100 wells on land for which it paid 25 cents an acre. It piped the gas northward to Fort Dodge and Garden City, Kans., but failed to interest other communities and eventually went broke. Interstate exportation be-

**BASEMENT OF COMPRESSOR BUILDING**

View along one side showing gas, water and compressed-air piping at the right. At the left are part of the row of individual concrete foundations for the compressors. Near the base of each one is a heat exchanger for cooling the lubricating oil used in the compressors.

gan in 1930, when Panhandle Eastern Pipe Line Company started laying a line that eventually delivered gas to Detroit, Mich. About the same time another transmission line was constructed to Denver, Colo., and Northern began work on its line to Omaha.

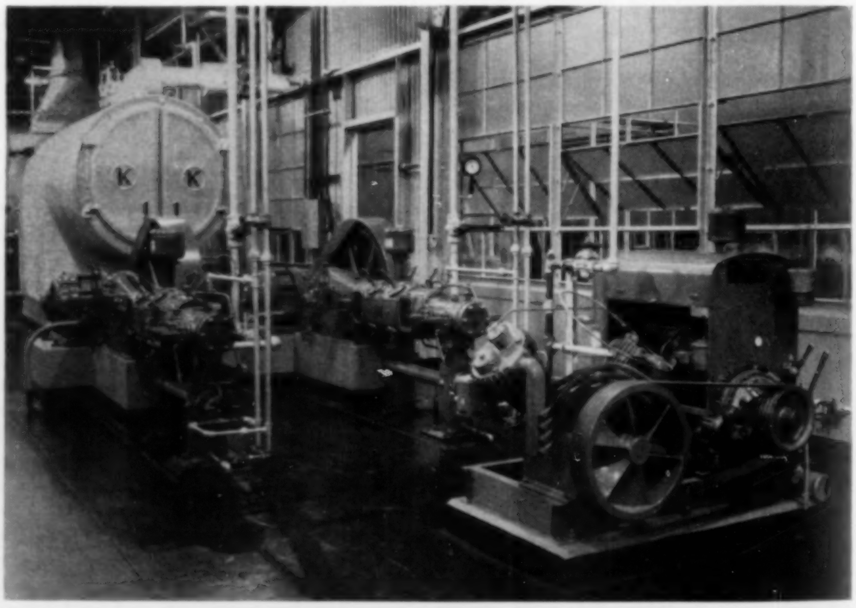
As now defined, the Hugoton Field runs 150 miles in a north-south direction. It has around 2700 wells, and when fully developed will support about 4000 on a basis of one to every 640 acres. Approximately 30 drilling rigs are active, and one of them can put down a hole to the gas sand in ten days. The field lies partly in three states—Texas, Oklahoma and Kansas—with the greater area in Kansas. In recent months both oil and gas have been struck east of its limits and it is believed that another field of importance exists there. Geologists call the region the Andarko Basin. With withdrawals from Hugoton approaching a billion cubic feet a day, it is estimated that deliveries can be maintained for more than twenty years.

Last February, in pursuance of its expansion program, Northern placed in operation a new field gathering station about 11 miles from Hugoton. It is the largest of the system's seven stations of this kind and represents the greatest block of compressor horsepower ever installed by the company at one point at one time. The site, which was planted to maize only a year before the compressors went on the line, was selected because it has an adequate underground source of water and a subsoil stable enough to support the heavy machines. The station is independent of all outside utilities except the telephone. It pumps its own water, produces its own electricity and has a 2-way radio hookup with the rest of the system. Plans for it were drawn and construction was supervised by Northern Naturals engineering department in Omaha. The general contractor was Tellepsen Construction Company, Houston, Tex.

Hugoton Station is situated so that it can transmit gas either northward to Holcomb Station or eastward to Sublette Station (see accompanying system map). Advance engineering studies were based on the knowledge that the station would receive up to 318,905,000 cubic feet of gas daily, all from the area lying west of the Hugoton Field, and that it would come in at a pressure of 244 psi. Maximum dispatching conditions provided for the transmission of 238,533,000 cubic feet daily to Sublette and 76,872,000 cubic feet to Holcomb at a pressure of 457 psi, with 3½ million cubic feet consumed as fuel. To meet these conditions it was computed that 13,145 compressor horsepower would be needed. The fact that the capacity of the installation as made has a surplus of only 55 hp over the theoretical horsepower required to do the job shows how much reliance is placed in modern gas engine-driven compressors.

The plant consists of ten Ingersoll-Rand 1320-hp Type KVG units. Each has twelve 15¼x18-inch power cylinders arranged in the form of a V and driving three 11¼x14-inch horizontal compression cylinders. Welcomed by operating men is the fact that all 120 power cylinders are identical and that a single replacement unit will fit any one of them. That is also true of the 30 compression cylinders.

The compressors are designed to handle the maximum specified load at a minimum suction pressure of 200 psi and



**COMPRESSORS FOR STARTING GAS ENGINES**

Compressed air at 250 psi pressure for starting the gas-engine drivers of the main compressors and of the generators is furnished by three smaller units. Farthest from the camera are two Ingersoll-Rand straight-line machines each powered through V-belts by a G-E 30-hp motor. These are used whenever current is available, but the unit at the right is ready to take over should electricity fail. It is an I-R air-cooled machine driven by a Waukesha gasoline engine. In the background is a Kewanee 100-hp boiler that supplies the buildings with heat during cold weather.

a maximum discharge pressure of 500 psi. These conditions, it will be noted, differ from existing ones. However, as gas-well pressure declines, suction pressure likewise will tend to drop but will be maintained at a minimum of 200 psi by means of intermediate booster compressors. In fact, some are already in service in sections of the field where steady withdrawals have reduced the pressure considerably below the field average.

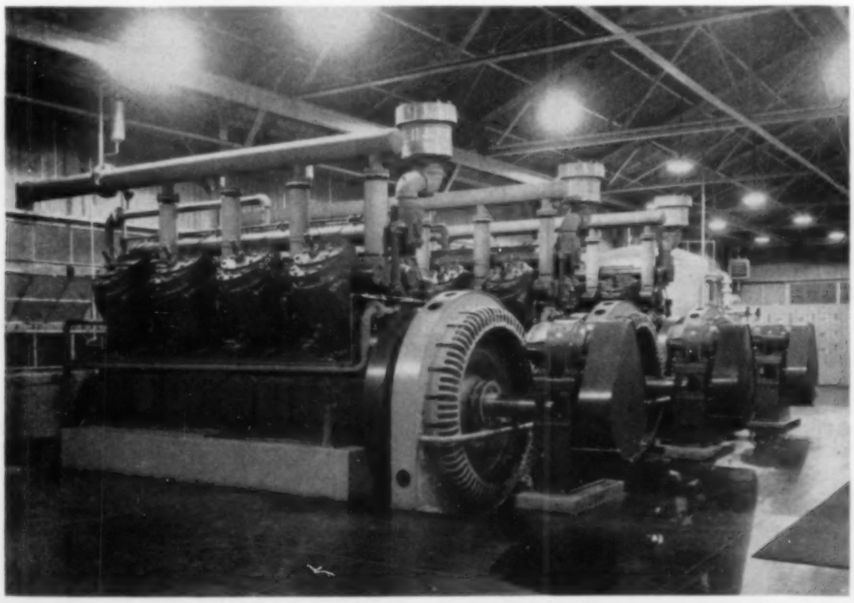
The compressor building has a full basement with 10 feet of headroom from floor to ceiling. The foundation for each 61-ton engine-compressor extends down through this space to firm ground and consists of a block 22 feet 5 inches long, 16 feet 9 inches wide and 11 feet 3 inches high. It contains 160 cubic yards of concrete and a ton of reinforcing steel. The basement floor is a mat of 805 cubic yards of concrete 20 inches thick.

Extending along both basement side walls are pipes carrying gas and water to and from the twelve units overhead and compressed air for operating maintenance tools. The gas for transmission flows to each compressor through an 8-inch line and leaves it at higher pressure via a 6-inch line. Gas used as engine fuel is reduced in the metering building from the line pressure at which it enters the station to about ½ psi and again dropped to about 6 inches of water pressure before going to the individual engines. Air for mixing with the fuel gas comes from outside and is delivered to each unit by a 14-inch line. From an elevated intake, it passes through an Air-Maze multiduty filter having a traveling screen that is immersed in oil during each circuit.

**OMAHA OFFICE BUILDING**

Northern's headquarters staff grew so fast that in 1950 it was using rented space in five different Omaha buildings. To bring everybody under one roof, a 7-story structure was erected on the edge of the business district and occupied in December, 1951. Resting on 270 concrete piles, it provides 55,000 square feet of floor space, but construction is already underway on the first of two wings. Completely air conditioned, the building has 1100 fluorescent lamps. Honeycombed "Quick-In" flooring supports permit placing a telephone or electric outlet within 6 inches of any designated spot. The heating plant normally burns natural gas, but facilities for switching to fuel oil make it possible to distribute the gas to customers on peak-demand days.

Incorporated in the suction and discharge pipes leading to and from the compressors are Fluor pulsation dampeners. Their effect is to iron out the succession of surges or "puffs" that characterize the flow of gas into and out of the reciprocating compressor cylinders. The dampeners consist of baffles and other structures enclosed in enlarged sections of piping at each compressor. They are designed to reduce the amplitude of line pulses by 90 percent without lowering the pressure of the gas by more than one-half of one percent.

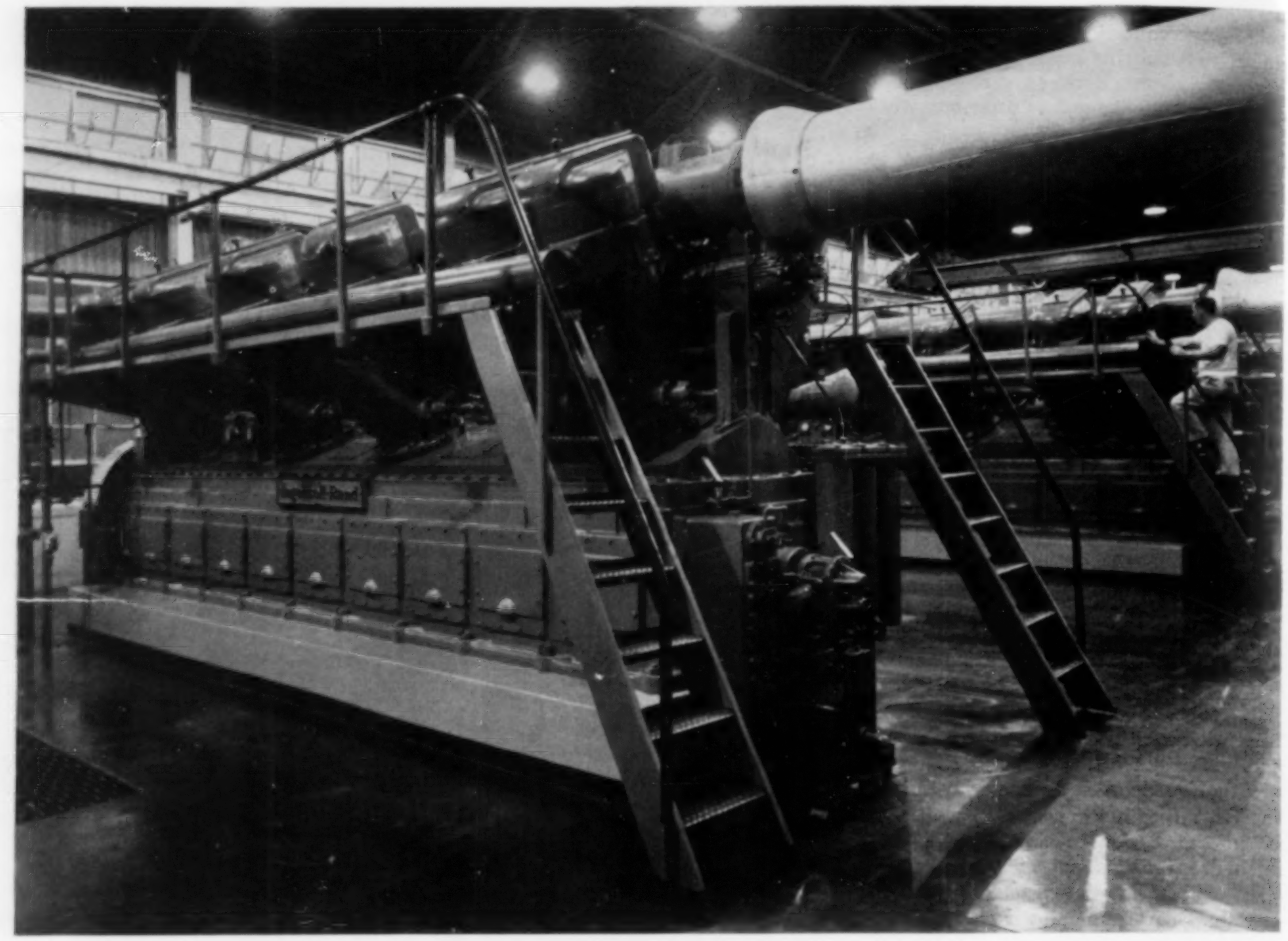


**GENERATING UNITS**

Power for operating motors and current for illumination is furnished by the three generating sets shown. Each consists of an Ingersoll-Rand 385-hp, 8-cylinder gas engine driving a General Electric 250-kw, 480-volt, alternating-current generator.

Water, required principally for cooling the cylinders of the gas engines and compressors, is obtained on the property from three wells ranging in depth from 290 to 300 feet. They are guaranteed to yield 175 gpm each, but actually deliver around 250 gpm. Most of the time only one or two of them are in service, the water being delivered to an overhead storage tank from which it is withdrawn as needed. The water contains 14.9 parts per million of insoluble mineral salts, and that portion of it which is used for cooling purposes is treated with a resinous zeolite softener before it flows into one of three covered reservoirs underneath the floor at one end of the Auxiliary Building. Two of them measure 12x32 feet, the third one 12x16 feet, and all are 11 feet deep.

These pits are part of a closed circulating system for the soft water, which is used over and over again for cooling and which, during each circuit, is cooled in turn by passing it through coils in a cooling tower. Four 30-hp vertical centrifugal pumps, each rated at 1600



ANOTHER COMPRESSOR VIEW

This picture shows the trimness of the gas-engine side. The rounded projection about 3 feet above the floor at the right end is a lubricating oil pump. The cylindrical vessels just beyond it are oil filters. During each cycle, the oil goes to the basement, where it is cooled by water circulating through a heat exchanger. The large light-colored, horizontal pipe overhead carries filtered combustion air to the gas engine from outside the building.

gpm against a head of 53 feet, take suction in one of the reservoirs and circulate softened water through the engine and compressor cylinders, thence to the tower and back to the pit. Five other similar pumps, each with a rated capacity of 1750 gpm against a 52-foot head, lift softened water from the two other reservoirs to the top of the tower, where it is sprayed through seven spreaders, one of which serves each cell of the structure. The tower was made by Fluor Corporation and is the largest one in Northern's system.

The oil that lubricates the engines and compressors is cooled in much the same manner as the jacket water. More than 2000 gallons is circulated in the system by individual pumps on each compressor unit. Additions are made as needed from an outside storage tank with a capacity of 12,500 gallons. Each unit is equipped with a gear pump to feed lubricating oil at constant pressure to all moving parts of the engine. A separate force-feed lubricator meters the oil to the compressor cylinders and packing glands.

Electricity for lighting and for driving motors that operate pumps, cooling-tower fans and other auxiliary equipment is furnished by three General Electric 480-volt, 250-kw, alternating-current generators each powered by an Ingersoll-Rand 385-hp, 8-cylinder gas engine similar in design to those that serve the gas compressors. Engine exhausts are provided with Maxim silencers.

Three Ingersoll-Rand air compressors—tiny compared with the gas compressors—supply air at 250 psi for starting the gas engines. Two are Class ES, horizontal 2-stage units driven through V-belts by G-E 30-hp motors. The third, for emergency use when electric current is not available, is an air-cooled Type 30 powered by a Waukesha gasoline engine. The compressors discharge into three outdoor storage tanks 36 inches in diameter and 20 feet long. From these receivers, pipes carry the air to each engine and also distribute it throughout the machinery areas where, after it is reduced in pressure, it operates pneumatic tools of different kinds and paint-spray guns utilized periodically for maintenance and housecleaning purposes.

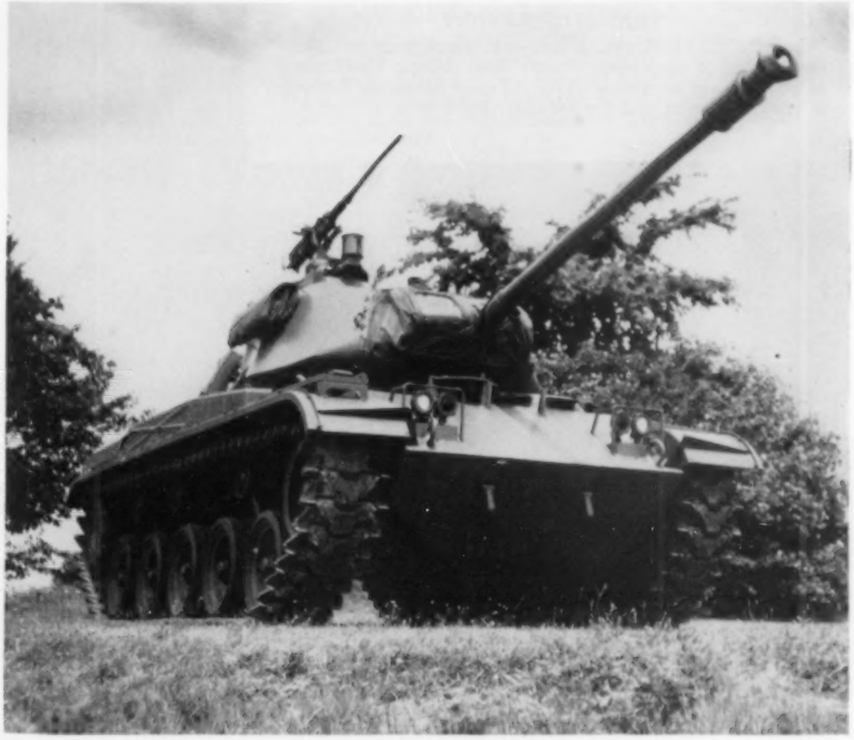
As the gas comes from the wells fully saturated, it has to be dehydrated to prevent condensation in the lines that would lead to freeze-ups in winter. Some of the moisture—up to 1000 gallons a day during cold weather—is taken out there, and the remainder is extracted at either the Holcomb or Sublette station. The Hugoton dehydration plant, which receives the gas immediately after it is compressed, is of the wet type and uses diethyleneglycol as the absorbent. Gas rising in six towers containing seven trays equipped with bubble caps surrenders its moisture to the descending hygroscopic chemical. The latter is then heated in gas-fired stills to drive off the water in the form of vapor and is recirculated.

Six men to a shift or tour run the entire compressor and dehydration plant, and there is an office staff of three men. Operating men, with the exception of key personnel, are recruited locally and trained for their jobs. Maintenance is handled by a separate crew. Sigurd Vikesdal is station superintendent.

# Cadillac Tank Plant

### Motor Car Manufacturer Turns Out Walker Bulldogs for Army in Cleveland

**Stanley Bell**

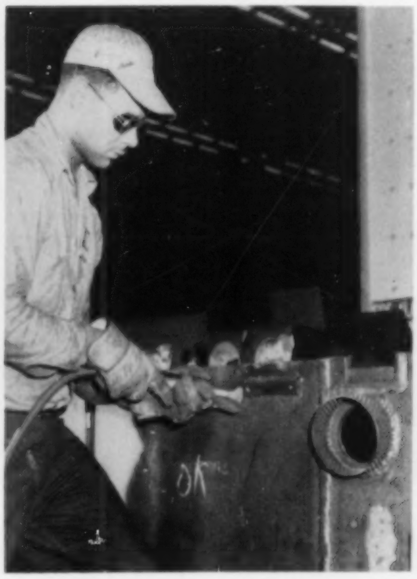


**WALKER BULLDOG**

Cadillac has been producing armored land craft like this one since March, 1951. It is classed as a light tank (26 tons), but has more punch than the medium tank of World War II.

IMMEDIATELY after V-J Day, while industry was clearing its plants of government tools and worrying about getting back into commercial production, the Ordnance Corps started a combat-vehicle development program based on the lessons learned during the war.

Early in 1948 the Cadillac Motor Car Division of General Motors Corporation, along with other representatives of industry, was invited to attend an Ordnance Industrial Mobilization meeting held at the Detroit Arsenal. At that time the Ordnance tank and automotive programs were outlined and many new tanks and components to replace World War II equipment were displayed. The theme of the meeting was design simplification, ease of maintenance through better accessibility, and greater interchangeability of major parts between the various vehicles. In addition, the new units were to provide greater armor protection than the older models and have increased fire power and mobility.



**TWO OUT OF TWO THOUSAND**

Approximately 2000 pneumatic tools speed multitudinous operations and save muscular effort. Shown are an I-R size G grinder (above) and a weld-flux scaler removing excess metal from the hull of a tank.

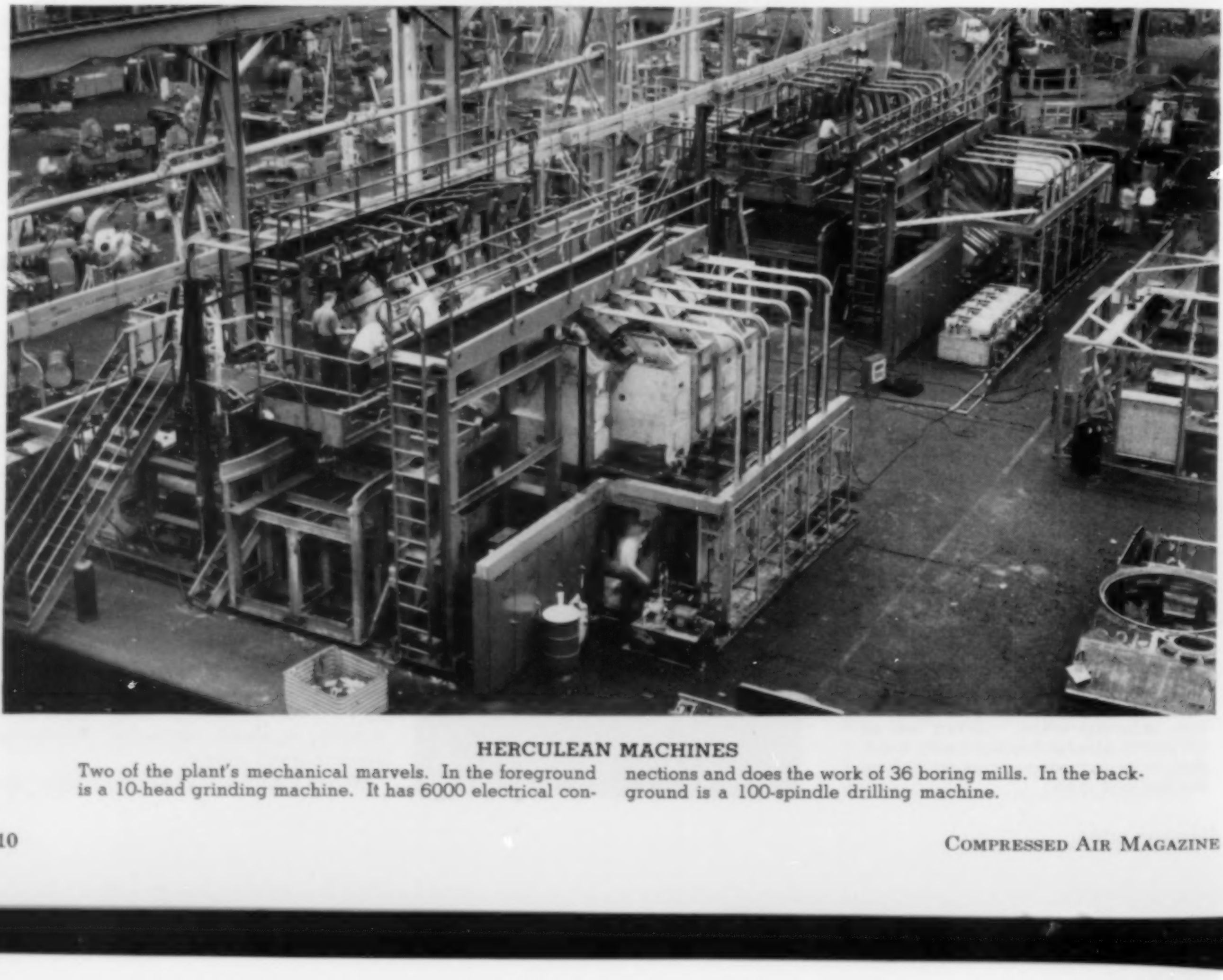
Ordnance was interested in the reaction of industry to the program and, further, wanted to know how long it would take to place tanks in production should that become necessary. Inasmuch as Cadillac was the design agency and the principal manufacturer of light combat vehicles during World War II, the concern was requested to make a Phase I Study for the mobilization planning of the new light tank and, when that was completed and submitted to Ordnance, a Phase II Study which involved more detailed information and planning. Before the latter was concluded, it was proposed that Cadillac consider producing a quantity of the T41E1, as the vehicle was designated.

The tank, which was later to be named the Walker Bulldog after General Walton Walker who gave his life in Korea, weighs about 52,000 pounds and has excellent fire power, mobility and armor protection. Its 76-mm high-velocity gun, which is 2 feet longer than the 90-mm gun on the medium tank of World War II, is equipped with an evacuator mechanism that permits the discharge of up to 200 consecutive rounds without excessive accumulation of fumes in the fighting compartment, as well as with a muzzle brake that lessens the force of the recoil. It is powered by a horizontally opposed, air-cooled, 6-cylinder supercharged engine.

When Cadillac was asked to make the

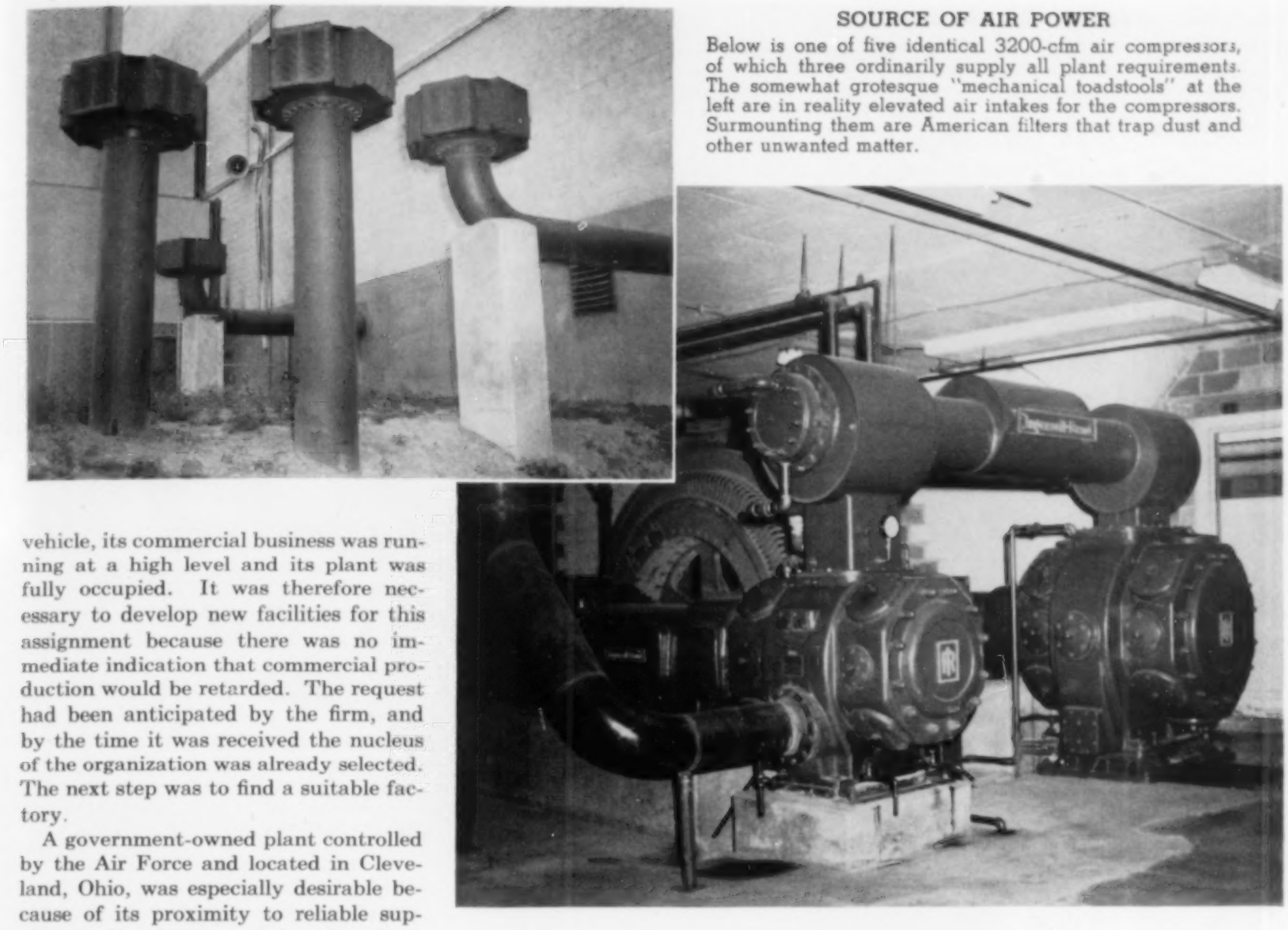
**TRANSFORMATION**

When Cadillac took over a former airplane plant in Cleveland, Ohio, it contained, among other things, 12000 tons of government soybeans (right). Today the scene (below) is vastly different and the building hums with activity.



**HERCULEAN MACHINES**

Two of the plant's mechanical marvels. In the foreground is a 10-head grinding machine. It has 6000 electrical connections and does the work of 36 boring mills. In the background is a 100-spindle drilling machine.



**SOURCE OF AIR POWER**

Below is one of five identical 3200-cfm air compressors, of which three ordinarily supply all plant requirements. The somewhat grotesque "mechanical toadstools" at the left are in reality elevated air intakes for the compressors. Surmounting them are American filters that trap dust and other unwanted matter.

vehicle, its commercial business was running at a high level and its plant was fully occupied. It was therefore necessary to develop new facilities for this assignment because there was no immediate indication that commercial production would be retarded. The request had been anticipated by the firm, and by the time it was received the nucleus of the organization was already selected. The next step was to find a suitable factory.

A government-owned plant controlled by the Air Force and located in Cleveland, Ohio, was especially desirable because of its proximity to reliable suppliers and to a concentration of workers trained in heavy manufacture. However, it had been designed and built for aircraft assembly work during World War II and involved extensive modifications to make it suitable for the manufacture of the Walker Bulldog. Furthermore, the structure was being used as a warehouse for 24 million pounds of soybeans, a 15,000-ton press captured from the Germans and several thousand tires. It took just three months to move these materials out and the tank-building machinery in. Meanwhile, the alterations were formulated and put into effect.

One of the first improvements undertaken was the erection of a modern disposal plant for waste materials such as cutting and soluble oils and other products which would contaminate the neighboring streams. Because considerable welding was to be done, the ventilating system had to be expanded to change the air frequently so as to dissipate the fumes. It now handles more than one million cfm. Water, power and compressed-air facilities all were inadequate.

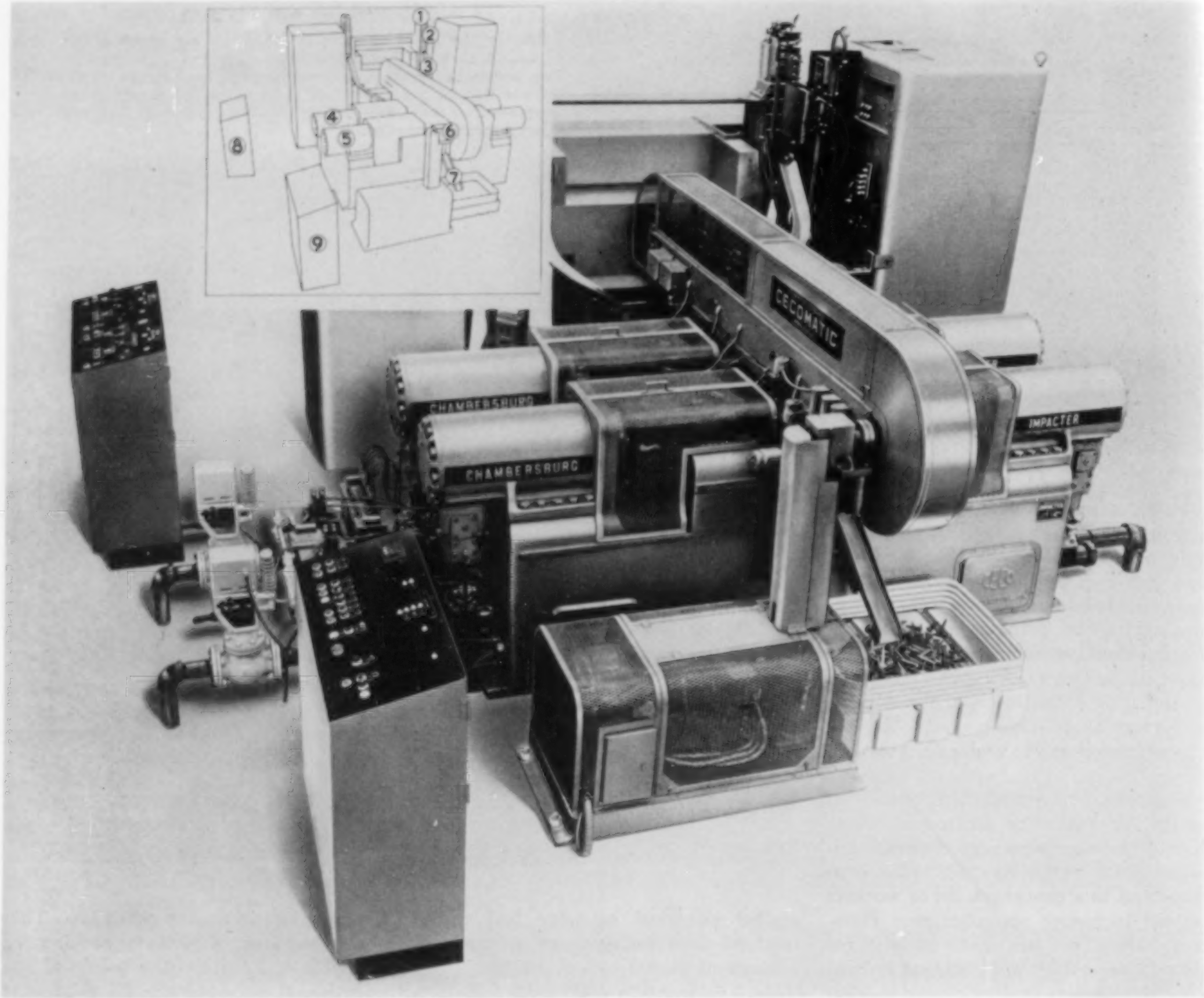
With water requirements twice as much as the existing system provided, it was necessary to lay 10,000 feet of 24-inch main from the city to a reservoir and pumping station constructed by Cadillac on its property. The installed electrical capacity had to be doubled, and today there is available a block of 35,000 kva at 132,000 volts. This is reduced to 4800 volts and then stepped down by secondary transformers to 440 volts for the operation of tools and machinery. This called for an entirely new distribution network, conductors and bus ducts.

The compressed-air system also is new and consists of five 2-stage Ingersoll-Rand units with a total capacity of 16,000 cfm. Each is driven by a 600-hp synchronous motor, and for starting is equipped with a 7½-kw direct-current generator to activate the electrical field. Each also has its own aftercooler, a 5x16-foot air receiver and an outside air intake with filters and louvers. But before the machines could be installed, the compressor room had to be enlarged from 500 to 8750 square feet and piping laid throughout the building.

All told, the air-supply system is made up of 27,000 feet of lines: 7000 feet of "big" piping ranging from 6 to 14 inches in diameter and 20,000 feet including everything under 6 inches. Take-offs are 2 inches in size, and the lines leading into the different departments of the factory usually have a diameter of ½ inch. Only three compressors are used at a time, thus giving the maintenance men ample opportunity to keep the machines in tip-top condition. This makes a volume of 9600 cfm continually available and reaches the points of application at a pressure of 95 psi. It is used primarily to operate the more than 2000 air-powered tools throughout the plant. Most of them are chippers and grinders so essential where heavy welding is done.

Compressed air also plays an important part in the paint-spraying and drying operations. There are five spray booths and as many ovens which consume, respectively, 200-1600 and 1000 cfm. In the booths air is put to work atomizing the paint, and in the ovens it is mixed with oil fed to the burners to produce the flame. In the safety-conscious plant it serves still another purpose. It powers twelve ¼-ton and six 1-ton air hoists mounted on cranes that travel over the paint-mixing area. Operating them with air instead of gasoline or electric motors removes danger of sparks or excessive heat that might cause explosions.

It took a lot of hard work to rehabilitate the aircraft factory and get production going, but the labor of thousands of employees, suppliers, Army men and others was rewarded on March 27, 1951, when Cadillac turned over the first Walker Bulldog tank to Army Ordnance officials three months ahead of schedule.



**SETUP FOR CONTINUOUS FORGING**

A dual Impacter unit with auxiliary equipment for heating and feeding blanks and delivering forgings. Numerals on the drawing are the key to the operation and parts, as follows: 1– Automatic feeder that delivers blanks to the induction heating element, 2, which includes a device that rejects underheated pieces; 3– chute that delivers stock to transfer equipment which puts it on a conveyor; 4– first Impacter rough-forges blank and then the second Impacter, 5, finish-forges it; 6– cutoff removes sprue from forging; 7– separate chutes direct forging and sprue to different tote boxes (second one is underneath the one that shows); 8– control panels for both Impacter elements; 9– control panel for entire handling and forging system, which Chambersburg calls its Cecomatic Process.

# Forging Hammer of New Type

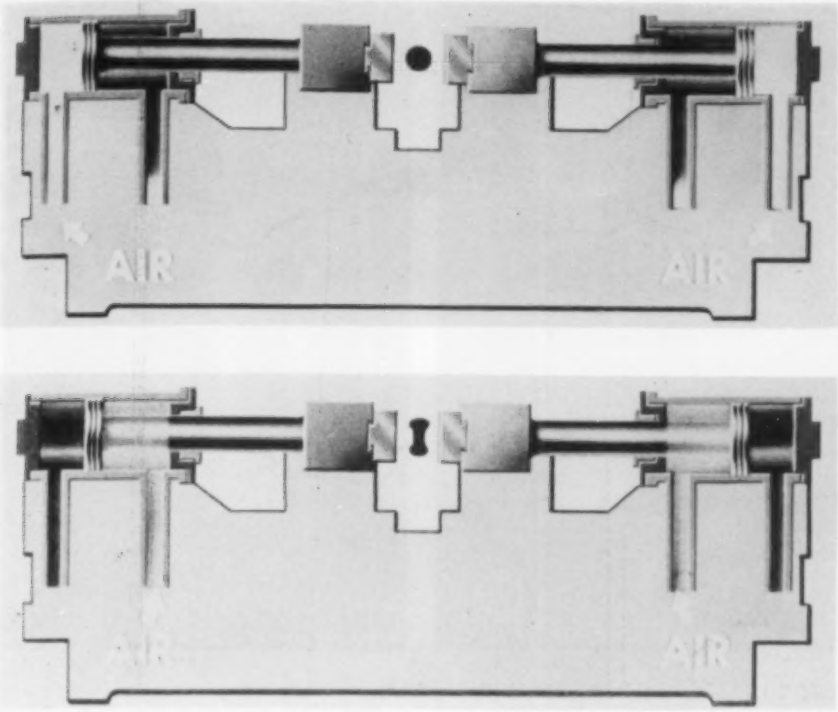
AN AIR POWERED machine developed by Chambersburg Engineering Company, of Chambersburg, Pa., is based on a new conception of forging metal. The Impacter, as it is called, represents the first departure from the traditional method of shaping metal by placing it on an anvil block and striking it with a descending weight. From time immemorial, blacksmiths and, later, mechanized forging hammers of various types have done it that way.

The Chambersburg creation has two striking heads that move toward each other in a horizontal plane at like speeds. The stock is suspended between them and struck by both heads at the same instant. Thus Impacting, which is the name the company has given the new process, is forging in mid-air. The hammer that does it promises to revolutionize present practices of forming many objects. For the first time, it permits the forging of small pieces by continuous-flow production methods, with both the feeding and delivery operations performed by conveyors.

It is a law of physics that when two inelastic bodies of equal mass travel toward each other at the same speed until they collide both come to rest and the energy is completely absorbed. This can be demonstrated by suspending two ivory balls of like mass on strings from a common point. If they are drawn apart equal distances and released simultaneously, they will collide without rebound.

In the Impacter, the two opposed reciprocating members are called impellers. They carry the forging dies and are moved in a horizontal plane by compressed air acting in similarly opposed cylinders. Stock is positioned in the impact plane and, during its deformation, absorbs the energy of the impellers which, immediately after striking, are returned to their starting points.

Most obvious among the several advantages claimed for the new machine is that it eliminates the massive foundation and heavy anvil long associated



**SECTION SHOWING WORKING PRINCIPLE**

The upper picture shows stock in position for forging. Compressed air is being admitted to the outer ends of the cylinders to drive the impellers and dies toward each other. In the lower picture the stock is shown after forging and air is being admitted to the inner ends of the cylinders to retract the impellers.

with a large conventional forging hammer. Because the energy is almost completely absorbed by the stock and the impellers, there is virtually no shock or vibration, and a coin will remain standing on edge on the frame of an operating Impacter. Consequently, it is possible to visualize factories where forging will be done on upper floors and even close to sensitive equipment.

Working of the stock from both sides rather than from but one side does the forging job better from a metallurgical standpoint. Because heated stock is in contact with the dies only at the instant of impact, the temperature of the dies remains low and they wear less than when the stock rests in the lower half of a die for a considerable period. On the other hand, in absorbing a large percentage of the energy of the impellers, the stock's temperature is increased appreciably. It can therefore be worked several times without reheating, and initially does not have to be heated as much as for forging by usual methods.

The Impacter uses less energy than other forging equipment to accomplish the same work. This is attributable to the fact that when a piece of metal is deformed from two sides its total movement, as it accommodates itself to the new shape, is less than when deformation is effected by hammering from one side only. As energy is the product of mass times distance traveled, shortening the distance effects a saving. Tests and mathematical calculations based on graphic comparisons of the deformation of a sphere by the two methods indicate that the Impacter's saving in energy amounts to 23 percent.

Precise placing of the stock, it is claimed, results in forgings that require little trimming, and this, in turn, saves material. In a typical continuous production line each piece will be carried into an Impacter suspended by a sprue welded onto it. This mechanical handling will eliminate the variation in positioning that is inevitable when it is done by hand. Also, because the operator will never handle or even be near the work pieces, his job will be safer.

As is usually the case when new machinery is developed, the manufacture of Impacters began with small sizes, and larger ones will be put into production gradually. Eventually, the Chambersburg management believes that its innovation will make it possible to turn out forgings much bigger than those produced today. At present, the size of the conventional hammer that can be installed is limited by the weight of the anvil block that can be shipped. That of the new machine, however, will be limited only by the size of the impellers that can be transported. Assuming, as the company does, that the maximum is 400,000 pounds, an Impacter that will deliver more than three million foot-pounds of energy is considered practicable. Supposing that the unit visualized is only 10 percent more efficient than the conventional drop hammer, then the Impacter would have a capacity nearly seven times that of a 50,000-pound steam hammer, which is the largest descending weight-type machine for impact die work so far built.

The Impacters now in service deliver blows of up to 6000 foot-pounds at practical forging speeds. International Silver Company has been using one for several years at its Meriden, Conn., plant to cold-forge steel knife handles. With a single blow, pieces are shaped at the rate of 50 per minute—3000 per hour. The entire process is automatic. Thompson Products Company, of Cleveland, Ohio, has an Impacter for cold-coining jet-engine compressor blades to fill an Air Force experimental contract.

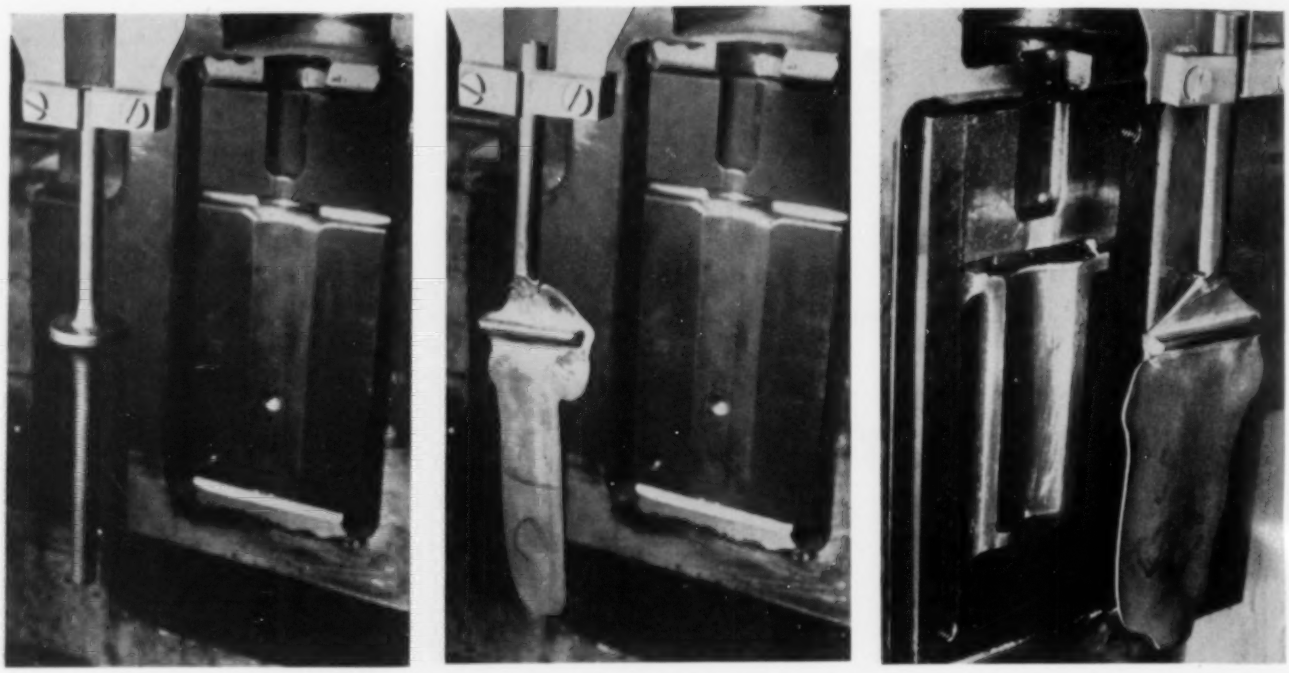
Packard Motor Car Company has put in service the first of four 6000-foot-pound Impacters being constructed for it to forge at least seven different blades for J-47 (General Electric) jet engines. The blades will be made from heated stock and extensive tests have shown that they can be formed so precisely that they will need only polishing and cold-coining afterward.

Each forging unit will have two sets of striking pistons or impellers equipped with different dies for sequential operations. Packard has been shaping the blades with 1300-ton presses, and one trimmer serves two of them. Plans are underway to provide four or six trimmers for each Impacter, indicating that from eight to twelve times the present output is expected from the new machines. Packard has likewise ordered two Impacters with ratings of 15,000 foot-pounds for use in forming jet-engine buckets.

Oldsmobile Division of General Motors Corporation also will use units of 6000 foot-pounds for rough-forging jet-engine blades, successful trial runs having been made at Chambersburg with test dies and stock. The forgings will be machined to final dimensions.

The technique of Impacting involves a new conception of how to forge heated metal effectively. It has always been considered essential that stock be thoroughly soaked with heat before it is forged, but the speed with which Impacters work makes that impracticable. In fact, one of the problems connected with the development of the Impacter was that of devising means of heating the stock fast enough to keep up with the forging operation. Coöperating specialists on heating equipment accomplished this and, in addition, assisted in working out feeding and delivery facilities to make the whole cycle automatic with push-button control.

Electric induction heaters have been designed especially for the service by The Ohio Crankshaft Company (TOCCO), of Cleveland, Ohio, while Selas



**SEQUENCE OF FORGING JET-ENGINE BLADES**

Left—Blank with carrying sprue welded to it in position for first blow. Center—Blank after receiving the first blow and about to be moved automatically to the second Impacter. Right—the second blow has been delivered and completed forging will move on to the trimmer. Production of 40 blades per hour is indicated.

Company, of Philadelphia, Pa., has developed satisfactory gas-fired units that burn a propane-air mixture. The equipment will heat as many as 180 small pieces per minute to the required forging temperature. While trying out the TOCCO stock-feeding system, Chambersburg engineers added a device to transfer pieces from the furnace to a conveyor belt with a blast of compressed air. Instead of being detrimental, fast heating seems to have beneficial effects. One decided advantage is that there is little time for the formation of scale.

The Impacter represents the fruit of more than fourteen years of engineering effort, the first drawings having been made in 1938. The idea on which it is based sprouted from a statement in a government publication that the passage of projectiles through steel changes the characteristics of the metal bordering the holes. As the affected metal is subjected to pressure for only an instant, the article started some thinking. After a horizontal, opposed-piston type machine had been conceived, Chambersburg sponsored a research project at Pennsylvania State College to investigate its practicality. This included a search of technical literature in several languages to learn if similar apparatus for the same purpose had been built and tried out elsewhere. Nothing whatsoever relating to the application of the principle to forging was found.

As compressed air is used to operate some of the company's earlier hammers, notably the Cecostamp that was introduced a few years ago, it was selected to power the new machine. Early in the experimental period a small working model was built and is still in existence. Chambersburg engineers knew that compressed air had the elasticity to assure the quick impeller action desired, but the real problem was to find suitable means of controlling it as required. That was achieved with electronic apparatus, which also controls other stages of the automatic feeding-forging-delivery cycle and without which the whole effort would have failed.

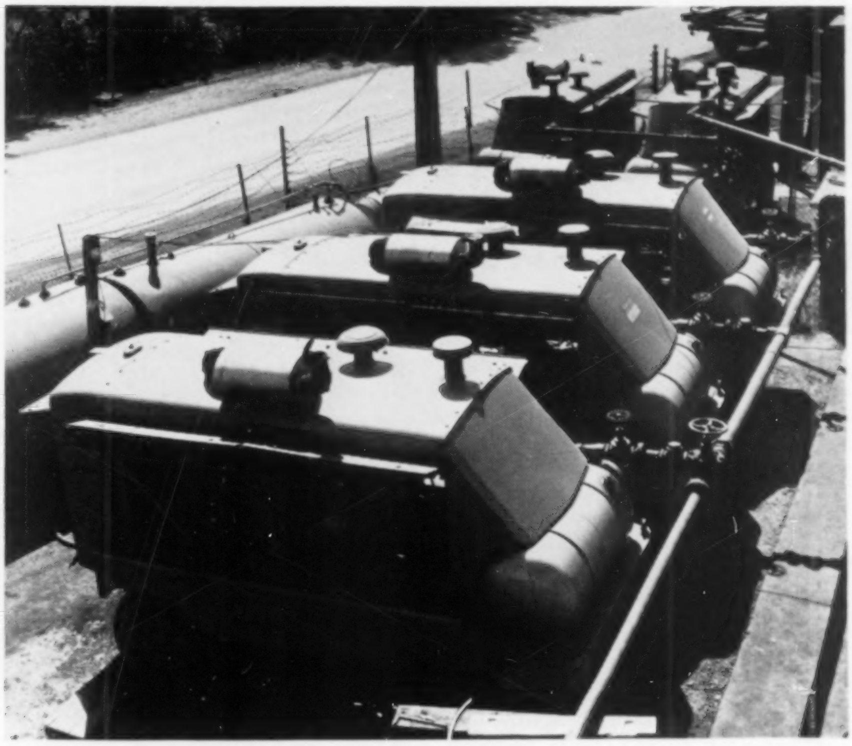
Actually, the air acts so fast that the impellers are in contact with the stock for less than 1/3000 second. The exact time has not been determined, but in motion pictures taken at a speed of 3000 per second, contact is not shown on two successive frames. Obviously, it was a remarkable achievement to devise means of opening and closing valves with the necessary rapidity and to synchronize the movement of the two opposed cylinders.

Air at 90-100 psi pressure, which is supplied by most plant distribution systems, will serve the machines satisfactorily. The air consumption per blow has been computed for Impacters of eleven sizes and ranges from 5.6 cubic feet for a 4000-foot-pound unit to 290 cubic feet for the huge 400,000-foot-pound model that will some day be built.

Before the Impacter was ready for unveiling, several units were constructed and discarded and a tremendous amount of research was carried out. One of the studies, which is still in progress, consisted of making up cylinders and cubes of wax having the same flow characteristics as metal. The bodies are light-colored and have darker cores. By deforming these and then cutting them into thin sections, it is possible to determine flow lines in detail, although it is a tedious task. It is also possible to calculate the energy required to obtain desired deformations and flow effects.

Offhand, it would seem that the Impacter has a bright future in store, and its prospective applications are almost legion. For example, at Packard, a survey indicates that when the hammers are no longer needed for filling defense contracts they can be put to work on regular automobile production. At least fifteen car parts can be forged with them and, because of improved flow of the metal, perhaps made better than by existing methods.

One service for which Chambersburg considers the larger sizes of its latest offspring well suited is the forging of car wheels. That operation involves the shaping of blanks weighing up to 400 pounds each. It is believed that the impacting blow would bring about the desirable radial flow of the metal not possible with the presses now used and that closer tolerances than are now the rule would be obtained. For that matter, it is pointed out by Eugene C. Clarke, Sr., Chambersburg's president, variations in the dimension of any forging from a set standard can be held to thousandths of an inch. Tolerance, he says, depends on how much money you want to spend to replace dies before they have become appreciably worn.



**NEST OF PORTABLES**

These five Gyro-Flo rotary units furnish 3000 cfm of air temporarily for testing Fairchild auxiliary equipment for airplanes. Flanking them on the left is a large receiver into which all discharge.

# Portable Compressors in Role of Stationary Units

### Fairchild Company Uses Five of Them Pending Completion of a New Factory

**Richard R. Reinheimer***

THE STRATOS Division of Fairchild Engine & Airplane Corporation, at Bay Shore, N. Y., is perhaps the largest user of compressed air in suburban Long Island. A recent increase in production and development work created a need for additional air for testing purposes. Because of lack of space to accommodate more stationary units and power to operate them, and also because a new plant for housing adequate testing facilities was under construction, the firm turned to portable machines for temporary service.

The compressors had to be capable of delivering a steady flow of clean, dry air for twenty hours a day and six days a week. Five Ingersoll-Rand R-600 portables were chosen, and have been furnishing the air needed for testing aircraft cabin-cooling and pressurizing units and pneumatic accessory drive equipment. It is believed to be the largest group of these relatively new rotary compressors so far put to work at one location.

Stratos turns out a large variety of airplane accessory equipment designed mainly for use in jet-propelled craft and in transport airliners. Rolling off its production lines are such things as air-cycle refrigeration units for cabin cooling, mixing valves for cabin air conditioning, and power turbines for driving auxiliary generators and hydraulic pumps. Behind these regular items, each tailored for a specific job, are many months of research and development work.

Testing plays an important role in the production picture at Stratos. In addition to the standard acceptance tests to which each unit shipped is subjected, a series of development tests are conducted. This program usually involves calibration, altitude, endurance, and overspeed tests. In the case of many products these are dependent upon compressed air. In normal aircraft installations, the equipment operates on air bled from the jet-engine compressor.

To simulate the bleed-air supply, a large manifold carries the compressed air to the working area and distributes it to the various test cells in each of which it is heated electrically to a high temperature. It is carefully regulated to suit required temperature ranges, filtered and throttled to produce specified inlet conditions. Several cells are in use simultaneously, generally with different models, and call for varying inlet conditions and quantities of air flow.

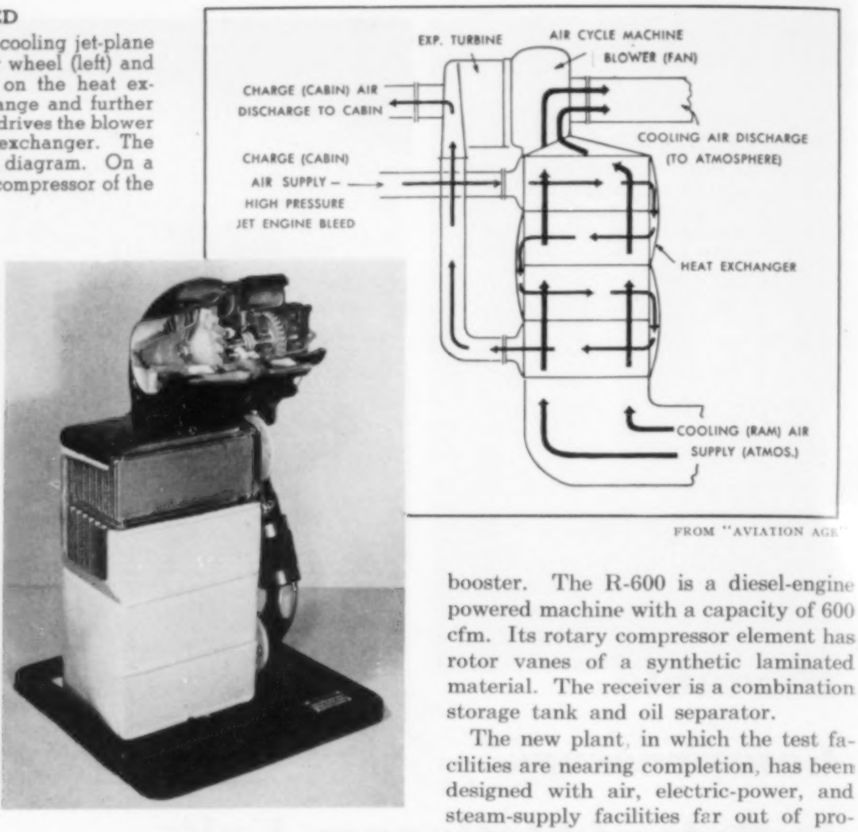
One of the products (illustrated) is a cabin-cooling unit for a jet-powered airplane. It consists of a blower or fan and its turbine-wheel driver, all mounted on an integral shaft and balanced to a few millionths of an inch-ounce to permit operation at a speed up to 73,000 rpm. This shaft assembly and its housing is installed on an extremely efficient air-to-air heat exchanger. (The system is also shown schematically.) The principle of operation is based on cooling by expansion of the air passing through the turbine.

Cooling air is continually drawn over the heat-exchanger surfaces by the fan, somewhat lowering the temperature of the bleed air. After flowing through the heat exchanger, the bleed air enters the turbine nozzles, drives the turbine and fan, expands, and emerges at a greatly reduced temperature. A usual set of operating conditions might be as follows: Bleed air enters the heat exchanger at 500°F and is cooled to about 0°F at the turbine exit if the cooling air temperature is approximately 150°F with a flow ratio of cooling air to cabin air of 3:1.

On the test stand, performance is closely checked to design specifications. Temperatures of the bleed air are regulated to plus or minus 2°F or closer, the cooling-air temperature is maintained within 2°F, and inlet air pressures are held to within plus or minus 0.2 inch of mercury. The resulting cabin-air and cooling-air flows are carefully measured by means of standard orifices and nozzles. The data thus obtained permit making calculations of efficiency and of turbine effective area, which must

---

*Plant Engineer, Stratos Division, Fairchild Engine & Aircraft Corporation



FROM "AVIATION AGE"

**ONE OF UNITS TESTED**

A Stratos air-operated packaged unit for cooling jet-plane cabins. It is cut away to show the blower wheel (left) and the turbine wheel. The assembly rests on the heat exchanger. Air is precooled by heat exchange and further cooled by expansion in the turbine, which drives the blower that moves the stream through the heat exchanger. The flow of air is shown schematically in the diagram. On a plane, operating air is obtained from the compressor of the jet engine.

fall within predetermined limits to enable the unit to pass its test.

Clearances between turbine wheels and housings of units are extremely small, usually in the nature of a few thousandths of an inch. For this reason it is absolutely necessary that the air be perfectly clean, because dirt or grit introduced into the system even in extremely minute quantities might cause serious damage or complete failure of a unit. The quality of the supply is assured by the use of pipe-line filters, which are under constant surveillance.

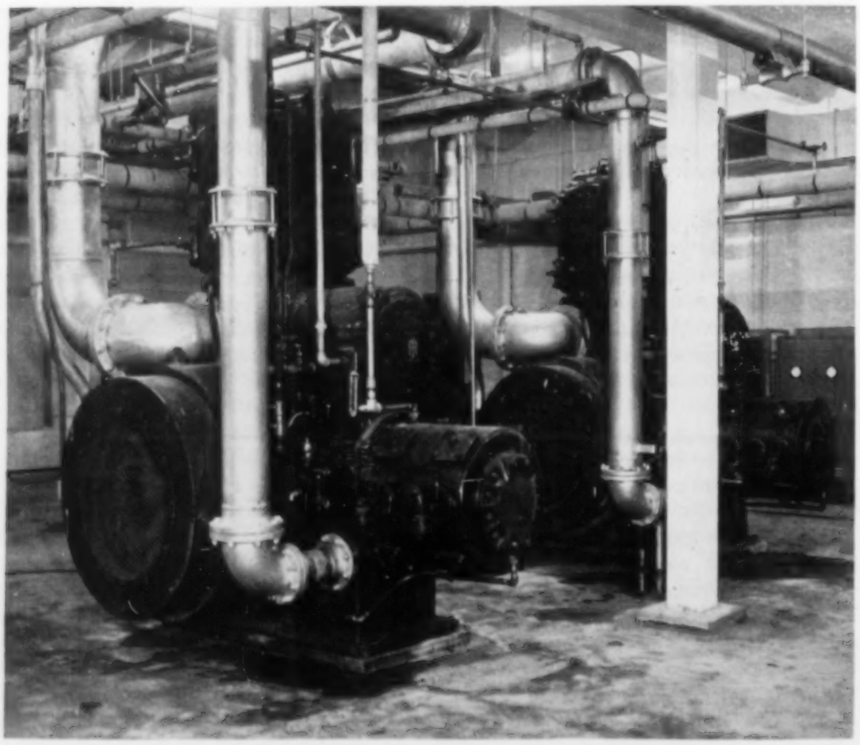
The equipment originally installed for testing consisted of four Ingersoll-Rand Type 40, air-cooled Motorcompressors, each with a capacity of 375 cfm at 100 psi discharge pressure. These were later supplemented by a 472-cfm Ingersoll-Rand Class ES-1 liquid-cooled horizontal unit, giving a total capacity of 1972 cfm at 100 psi pressure. A booster was also provided at that time to raise the pressure of the output of the four machines to 200 psi for certain intermittent high-pressure tests. The booster is an Ingersoll-Rand ES single-stage unit that has a rating of 160 cfm at 100 psi intake and 200 psi discharge pressure.

The R-600 portables were added gradually to supplement the permanent installation until, with the procurement of the fifth one, the air capacity totaled 4972 cfm at 100 psi pressure, plus the booster. The R-600 is a diesel-engine powered machine with a capacity of 600 cfm. Its rotary compressor element has rotor vanes of a synthetic laminated material. The receiver is a combination storage tank and oil separator.

The new plant, in which the test facilities are nearing completion, has been designed with air, electric-power, and steam-supply facilities far out of proportion to those usually found in an establishment of its size mainly to carry out production and developmental test programs. The plant covers an area of 144,000 square feet, including 34,400 square feet of office room, 62,000 square feet of machine shop and assembly space and 28,800 square feet of test area.

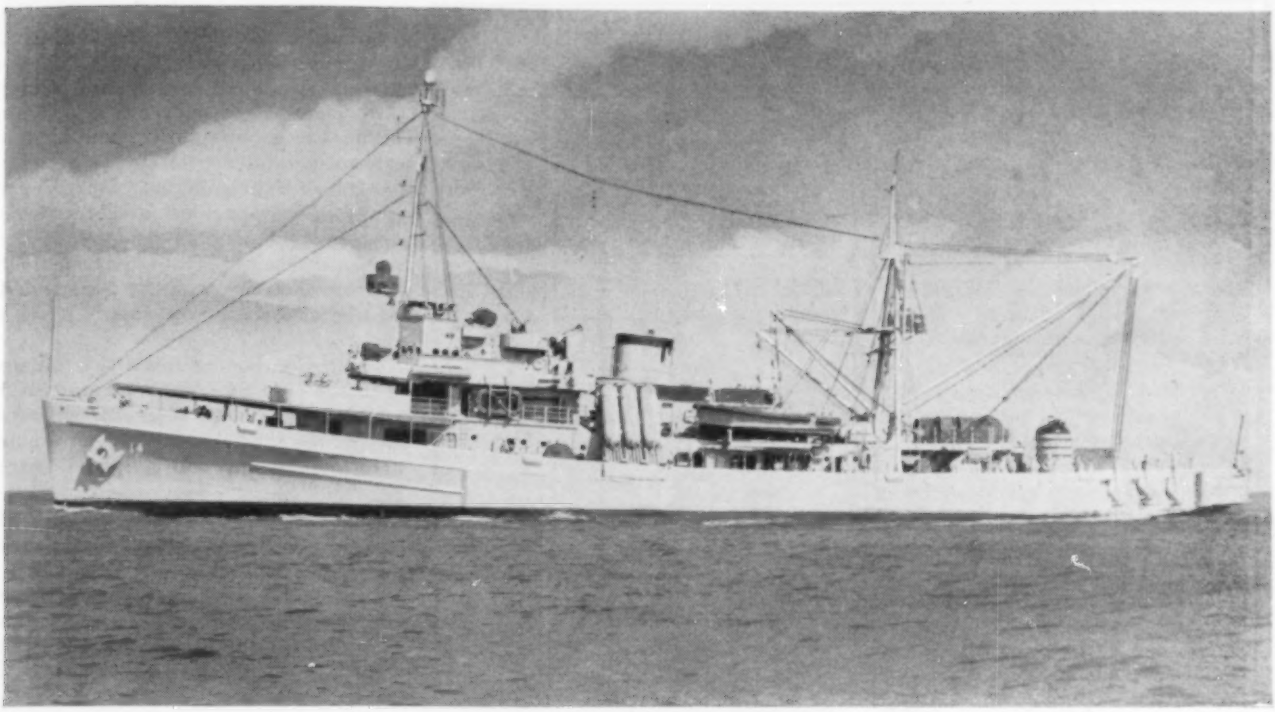
When finished, the stationary-compressor installation will have a capacity of 5388 cfm and will consist of the following Ingersoll-Rand units: Two Type XLE's each with a rating of 1133 cfm; one class ES, which is being moved from its present location along with the booster; and one 3-stage Ingersoll-Rand Type 4HHE rated at 2650 cfm at 100 psi discharge pressure. The latter machine, through a special unloading feature, will also be capable of delivering 2640 cfm at 300 psi discharge pressure.

Piping to the test area is being arranged to handle three different pressures—100, 200, and 300 psi—by means of separate manifolds. In addition, the machine shop will be supplied with air at 100 psi for the operation of spray and sandblast booths, balancing machines and other pieces of air-powered equipment. This shop line will be taken off the 100-psi test manifold in the basement. When completed, the system will furnish enough air to take care of current schedules. Although the portables will then be no longer required for their present purpose, some of them will possibly be retained to supply air for maintenance work and to serve as standbys when a stationary unit is taken off the line for servicing.



**IN NEW PLANT**

The new Fairchild factory will have stationary compressors with a total capacity of 5388 cfm. Included are these two compact motor-driven Type XLE machines.



OFFICIAL U. S. NAVY PHOTOS

RESCUE VESSEL USS "PETREL"

At least one of these ships is based in every submarine operating area. Their heroic mission is to save lives and raise sunken underwater craft. The rescue chamber or diving bell is visible on the afterdeck near the right end.

# Guardian Angels of the Submarines

## Navy's Rescue Vessels Stand Ready to Save Sunken Craft with "Transfusions" of Compressed Air

W. N. Johnson*

COMPRESSED air is the very lifeblood of today's submarine. Of the myriad uses of this precious fluid, perhaps the most vital is the routine blowing of ballast tanks to bring a submerged vessel to the surface. If a craft of this type suffers a casualty which prevents the use of her air systems, she will in most cases settle to the bottom and require outside assistance to regain positive buoyancy.

To meet such an emergency, the U. S. Navy has provided each submarine with special hull fittings to permit the rescue of her personnel and her own salvage and has produced a rescue vessel (ASR) of which at least one is located in every continental submarine operating area. No other naval craft has a more specific mission to perform, and none has received more careful and continued research to insure success.

The specially designed equipment required for this highly skilled operation is carried on board the rescue vessel and may be considered to fall within three major categories: mooring, lifesaving, and recovery of the submarine. The mooring facilities consist essentially of six sets of large buoys (spuds) with cabling and anchors, ship's main bow and stern anchors, winches, booms, hauling lines and associated fittings. For the rescue and salvage work the equipment includes a diving bell, compressed-air plant, hose assemblies and distribution system. Details of the bell are shown in an accompanying illustration, and its use will be explained later.

The compressed-air layout is elaborate and flexible and is made up of three independent but interconnected systems, as follows:

Reserve, 3000 psi: Two 4-stage machines rated at 30 cfm at 3000 psi. Flask-type air storage totaling 876 cubic feet. This system also provides air reduced to 450 psi for the rescue bell.

Divers' supply, 400 psi: Two 2-stage units each rated at 150 cfm at 400 psi. Storage facilities include two air receivers with a total volume of 210 cubic feet.

Submarine salvage, 200 psi: Four 2-stage compressors each rated at 150 cfm at 200 psi. Two air receivers with a capacity of 210 cubic feet.

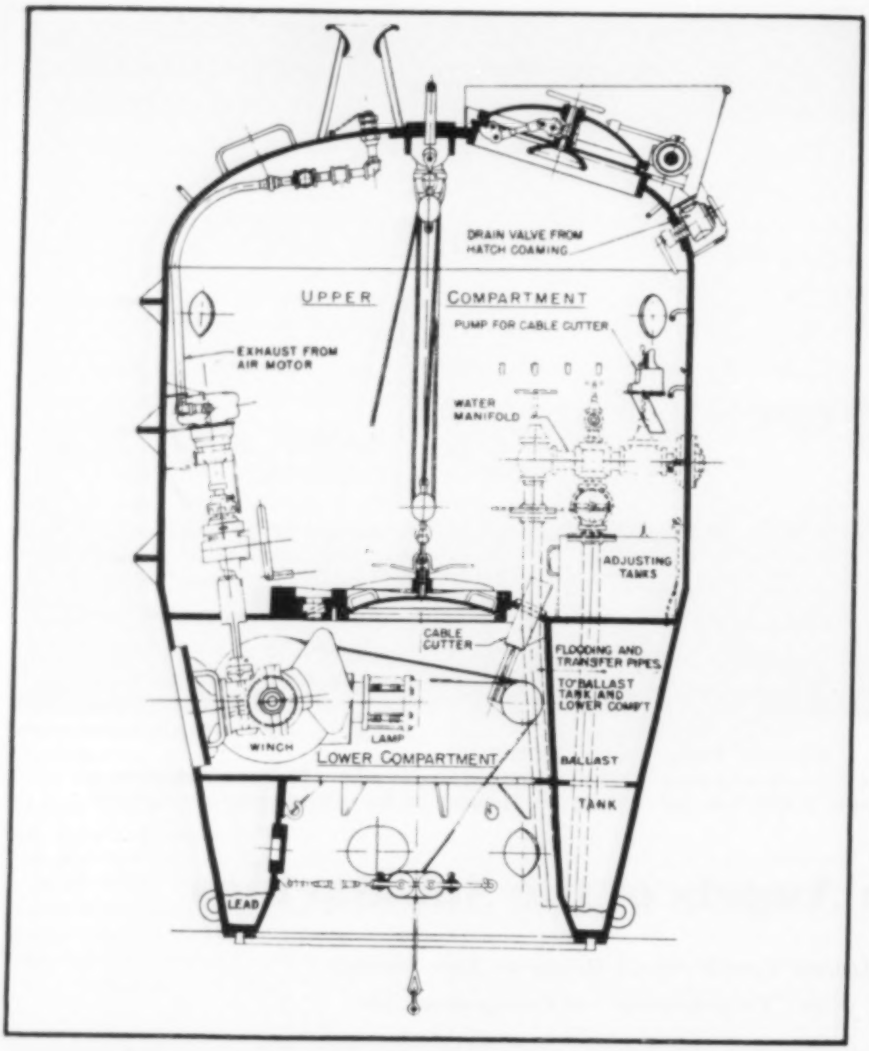
All compressors are of the heavy-duty, water-cooled, electric-motor driven type which offers maximum reliability and minimum maintenance. The extensive facilities for the storage of compressed air are installed to provide enough air to carry out rescue work even if all compressors are out of commission. Cross-connections permit any system to receive compressed air from any other of higher pressure.

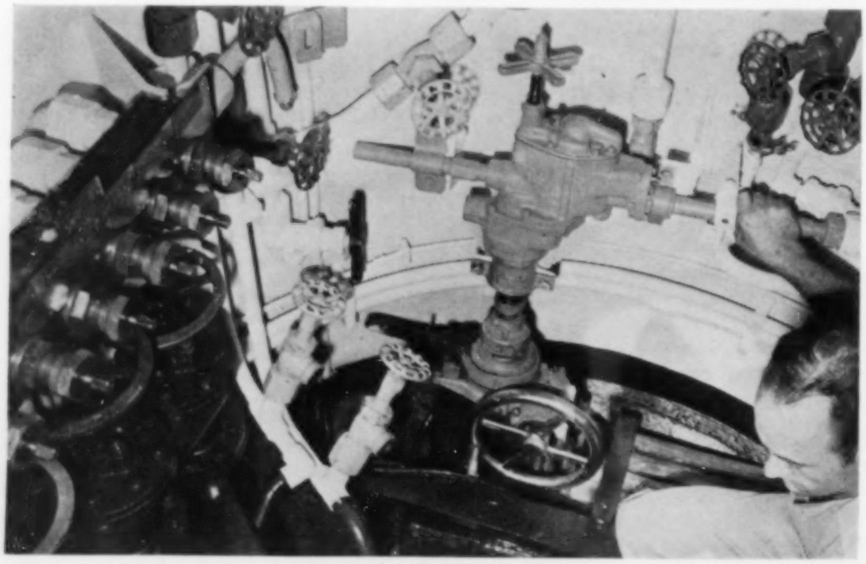
In order to make it plain how rescue-salvage operations are conducted, let us assume the following typical situation: A submarine has sunk, and because of material or personnel casualties requires outside help for survival. She has indicated her exact position by releasing a specially designed "messenger" buoy to which is attached a steel cable terminating at either the forward or after escape hatch.

Immediately upon the rescue vessel's arrival at the scene, the mooring operation is started and an attempt is made

---

*Lieutenant, U. S. Naval Reserve.





**INSIDE RESCUE BELL**

The diagram shows a cross section of the bell, which is pictured on our front cover. During descent and ascent, the lower compartment is flooded with sea water. When in contact with a submarine escape hatch, the water is blown out with compressed air and the hatch opened so that survivors can enter the bell. Directly above is seen a part of the upper compartment. In the center is an Ingersoll-Rand Multi-Vane motor that powers the down-haul winch. Valves that control blowing to attain the desired buoyancy are at the left.

to establish communication with the foundered craft to determine the extent of the disaster and the needs of those entrapped. Time is a critical factor throughout, because the amount of air within the submarine for breathing is extremely limited. If the men below are known to be suffering from a shortage of air or from chlorine or other toxic gas, the surface ship sends down a diver who attaches supply and exhaust air hoses to the affected compartments and signals for a continuous supply of fresh air.

For the purpose of this article, suffice it to say that mooring is accomplished by laying a pattern of anchored buoys around the submarine and then running lines to each buoy so the salvage vessel can "pull" herself into position right over the stricken craft. Next the rescue of the crew is undertaken by use of the diving bell, as follows:

The steel cable is disconnected from the messenger buoy and fastened to a winch in the lower chamber of the bell. This winch is driven by an air motor located in the upper chamber and is manually controlled by the rescue team that rides down with the bell. In this manner, the slightly buoyant bell actually pulls itself down to the submarine and centers itself directly over the escape hatch where the lower end of the cable is secured. Permanently connected to the top of the bell and running back up to the surface vessel are compressed-air supply and venting hoses, lighting and communication circuits and a steel hauling cable. The latter is kept taut, being fed into or out from the salvage craft according to the motion of the bell. It is used for hoisting only in the event something goes wrong with the mechanism of the bell.

After the diving bell has been pulled down over the escape hatch, the water in its lower chamber is blown to sea with compressed air, which is then quickly vented into the upper chamber and thence to the surface through a pressure-resistant hose. The resultant force of the sea pressure exerted down on the bell effects a watertight seal between it and the submarine. As soon as excess air pressure is vented off, the lower hatch of the bell and the escape hatch can be opened to permit transfer of the sub's personnel.

After the survivors have entered the bell (a maximum of nine men per trip) the two hatches are closed and the bottom compartment is flooded to equalize the pressure in the lower space and to break the seal. Ascent is accomplished by giving the bell positive buoyancy by adjusting ballast and allowing the down-haul cable to pay out slowly by running the air motor in reverse. At all times normal operation is controlled from within the bell itself. Upon transfer of the men to the rescue vessel, the bell again descends, repeating the foregoing cycle until all the survivors have been brought to the surface.

The final phase of the salvage work is the raising of the submarine. The problem here is to make the sunken vessel buoyant so she will rise to the surface and remain afloat. This involves blowing the ballast tanks and perhaps dewatering a flooded inner compartment. An alternative method in case of special circumstances is the employment of large submergible pontoons which can be strapped to the submarine's hull with steel cables.

As mentioned earlier, every compartment and ballast tank on the submarine is provided with external salvage valves and fittings identified by coded raised markings so a diver can locate any one desired by touch in total darkness. When the nature of the casualty has been determined either by communication with the men inside or by inspection of the hull, divers proceed to lead down air hoses, attach them to the compartment, tank or pontoon and open the valves in the lines.

Upon completion of their task, the underwater workers ascend and the rescue vessel delivers compressed air to the affected spaces, blowing the submarine to the surface. This operation requires considerable skill to prevent the loss of the craft through an excessive list or angle. The normal practice is to connect several air hoses—locating them forward and aft, port and starboard—and then carefully control the rate of blowing in each line so as to maintain an even keel.

Once the submarine has been surfaced, she is prepared for the voyage to a repair base. If the vessel has been torn open by a collision or explosion, additional buoyancy is provided by large salvage pontoons. During the slow, tedious tow into port she is kept afloat by a continual flow of compressed air to the affected tanks. Upon her arrival, she will receive a complete overhaul and later report back to the fleet for active duty. Her near-fatal experience will be just a memory to her crew, to those who saved her and to those who have casually read her story in local newspapers.

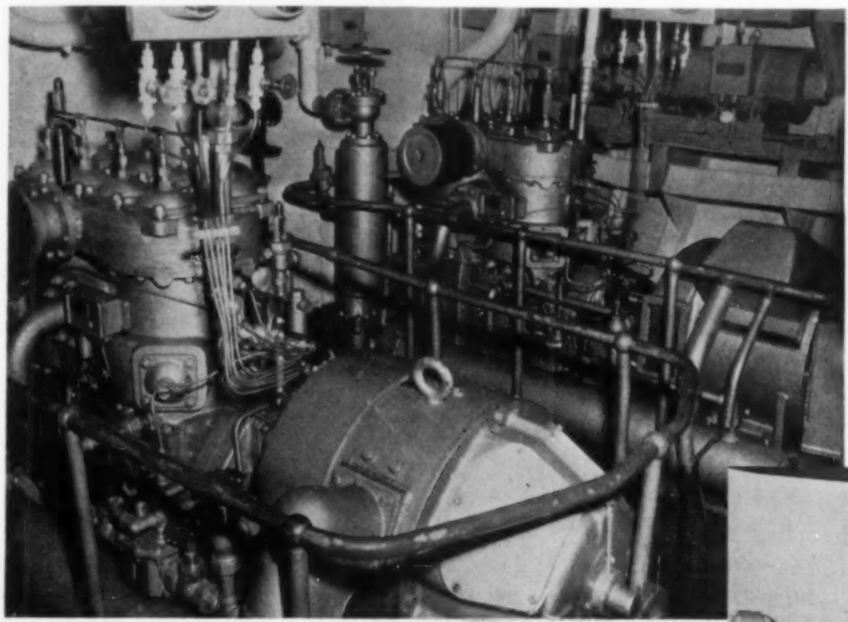
It is a tribute to the skill of the designers, builders and operating personnel of our submarines that we have suffered very few losses in this hazardous service. But, patiently alert, the special rescue vessels stand in constant readiness to come to their aid when disabled.

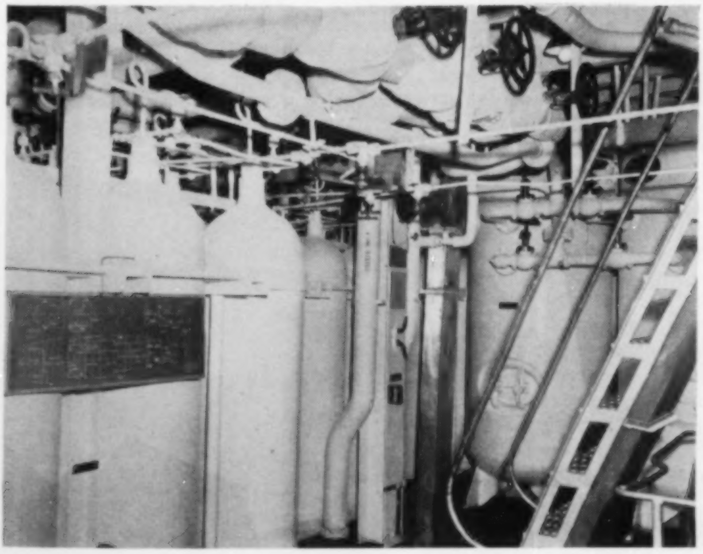
---

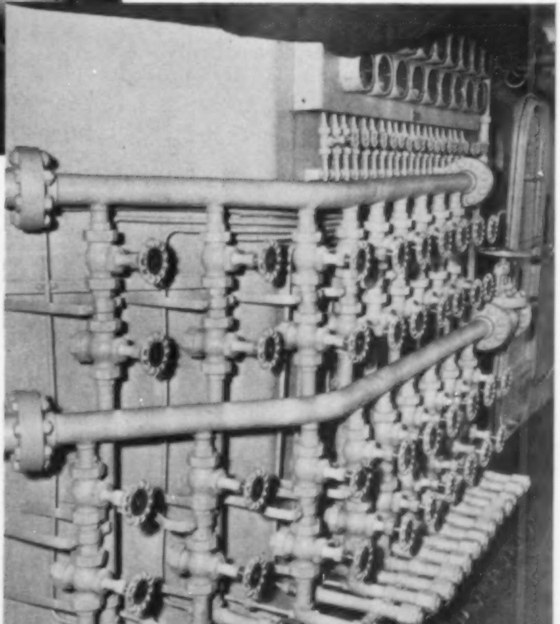
The assistance and co-operation of the officers of the USS "Petrel" (ASR 14) in the preparation of this article is gratefully acknowledged by the author.

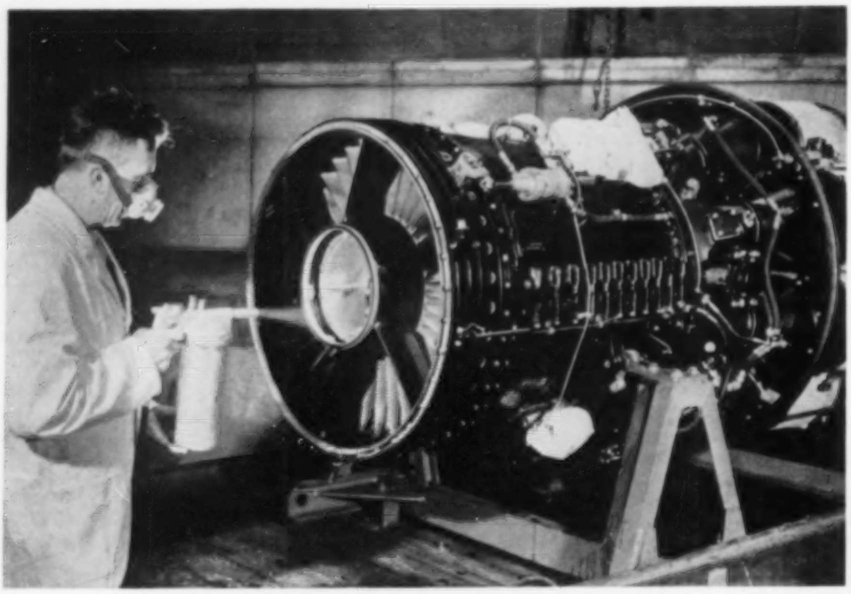
COMPRESSED-AIR FACILITIES

Each rescue vessel carries several air compressors to supply life-giving air. Shown in the upper view are two Ingersoll-Rand units: at the left is one of four that discharge air at 200-psi pressure into the submarine salvage system, and at the right is one of two 400-psi machines that serve the divers' air system. A section of the "Petrel's" air-storage facilities is pictured at the bottom-left. To hold the 3000-psi reserve supply alone there are 113 vertical flasks. For the distribution of salvage air as needed in raising a sunken vessel there are multiple connections for air hoses, lower-right. By carefully regulating the control valves, air is delivered evenly to the various spaces in the stricken submarine, giving it buoyancy to rise to the surface on an even keel.









**EASY TO APPLY**

Shown here are two kinds of air guns used industrially to apply Shell Oil Company's VPI rust preventive. The unit at the left is blowing the volatile chemical in powder form onto the inside surfaces of a Rolls Royce turbine engine with its maze of passages. The conventional-type gun, below, operates on a production-line basis in the plant of Wheeling Steel Corporation. It is spraying liquid VPI onto the inner walls of steel drums to protect them against corrosion during transit and storage.

## Poof — There Goes Rust!

A VOLATILE chemical called VPI, in combination with compressed air, is well on its way towards killing the bugs in conventional methods of corrosion prevention and helping to reduce the huge annual loss attributable to rust. It is particularly aimed at extending the storage life of metal parts and at simplifying protective packaging procedures.

VPI, which travels under the rather ponderous name of dicyclohexylammonium nitrite, is a product of the Shell Oil Company. Because it is slightly volatile it vaporizes readily and, what is of equal importance, does not react with or remove either the moisture or the oxygen. Instead, it works successfully in their presence by inhibiting their corrosive action. Actually, the nitrite ion is the protective agent and the vapor merely the carrier.

The properties of the preservative are imparted to metal surfaces in various ways. Objects may be dipped in a VPI water or alcohol solution; wrapping paper may be impregnated with it; and air guns, connected to suitable containers, may be used to apply it in solution or in its original powder form. Currently, the compressed-air method is proving highly effective because it makes it possible to reach otherwise inaccessible places and, by atomizing the chemical, to increase dispersion.

In VPI, air lines and aircraft-engine manufacturers are finding a preservative that enables them to store engines much longer than formerly under conditions of high humidity with the assurance that they will be protected against rust. Pan-American Airways, for instance, uses air guns to blow the powder into sections of engines where application by other means would be difficult, slow and incomplete. In all cases, an airtight covering is put on afterward to prevent escape of the safeguarding vapors.

Liquid spraying is practiced at the Wheeling Steel Corporation plant where VPI in solution is applied to the inner surfaces of steel drums to prevent corrosion during shipment. Formerly they were protected by a coating that had to be removed by the customer at considerable expense. Wheeling Steel uses conventional paint-spray guns and a 5 percent solution of VPI in special denatured alcohol. The amount required varies from 2 to 3 grams for a 5-gallon drum, 6 to 8 grams for the 30-gallon size, and 12 to 15 grams for a 55-gallon container.

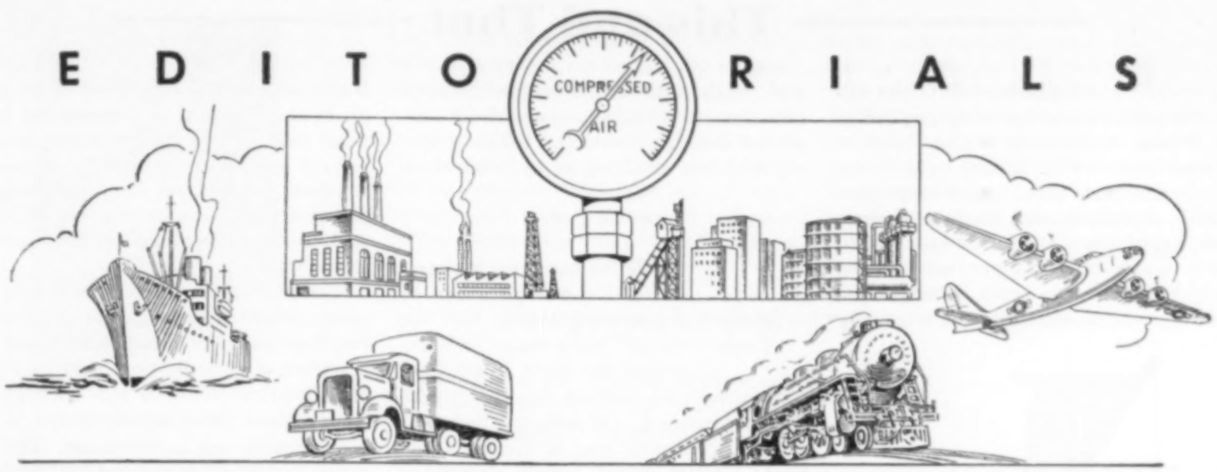
But no matter by what method the volatile material is applied, it eliminates much costly coating and stripping and is being used increasingly on metal parts and assemblies ranging from bearings, water pumps and gear cases to industrial filter elements to protect them during storage, transportation and even between processing steps.

## Improved Sealant for Porous Castings

SALVAGE of castings rejected because of microporosity is not new, but complete filling of the voids is an advance claimed by Polyplastex International, Inc. This is accomplished by impregnation with a thermosetting resin known as Polyplastex MC, which differs from other sealants in that it is converted into a solid that occupies the same space as it did when fluid. According to the manufacturer, the resin is resistant to a wide variety of solvents, salts, hydrocarbons and glycols, as well as to water, acids and weak alkalies. When cured it withstands continuous exposure to heat up to 350°F. Although it is hard, it is sufficiently resilient to allow for expansion and contraction of the metal due to temperature variations.

Impregnation may be effected by vacuum or pressure or vacuum and pressure. By the latter method, the one most commonly used, the castings are placed in a tank, as the illustration shows. After it is closed airtight, not less than 29 inches (mercury) of vacuum is applied, enough sealant is introduced to cover the parts, and air at 100 psi is exerted on the free surface of the fluid, forcing it into the porous areas. Following withdrawal, the castings are cleaned and cured. Their properties are not impaired by the treatment, which leaves no stain or film. Ferrous and nonferrous metals can be processed in this way.

# EDITORIALS



## TRADITION IS STRONG

ELSEWHERE in this issue a genuinely new pneumatic forging hammer is described and illustrated. It is so different from anything of the sort previously available that a thorough search of the patent records and technical literature in several languages failed to reveal anything even resembling it. This is almost unbelievable, for, despite its distinctiveness, the hammer is of simple design. Its essential working parts consist of two horizontal, opposed pistons that are shuttled back and forth in their respective cylinders by the expansive action of compressed air. Each piston or impeller, to use the manufacturer's language, carries half a die on its head. A blank to be forged is positioned midway in the path between the two rams which, upon advancing, strike it from both sides at once. The machine is more efficient than the older types and has the added advantage of producing virtually no shock or vibration.

It is indeed strange that no one had originated such a hammer previously, especially as it does away with the expensive and burdensome foundation and heavy anvil block of the conventional machine. We assume that the idea was never advanced before because the most natural way to pound anything is to let the force of gravity do some of the work. Thus, if given a choice, we instinctively strike downward when wielding a hammer, pick or any other implement or tool.

It is of interest to observe that one of the nearest approaches to the operating principal of the new type of hammer is found in the drill-steel sharpener. Invented around the turn of the century by J. George Leyner, this machine sharpens the bit end of a heat-softened piece of steel by repeatedly driving a shaping die against it. The steel is held stationary while the die reciprocates. In this apparatus only one forging element moves—it cannot be otherwise because of the nature of the work performed. It is significant, however, that it travels horizontally, which, up to now, has rarely been the case in a forging device. There is, of course, a perfectly logical reason why it does this, for it would be decidedly unwieldy and inconvenient to raise the steel to a vertical position and to place and hold it there in the machine. With a steel longer than 8 or 10 feet that would even be impossible in the average building, whereas steels up to 20 feet or longer are sharpened in a horizontal position.

Thus Leyner's sharpener, by a stretch of the imagination, can be visualized as the equivalent of half of the new hammer. It took a long time for someone to add the other moving half and thus give us something truly novel. It just shows that it is really difficult to break with tradition.

## THE HIGHWAY PROBLEM

HIGHWAY departments of the nation estimate that from $40 billion to $60 billion worth of construction is needed to put our road and street system in first-class condition. And each year, instead of diminishing, the sum grows greater. For instance, a Federal survey in 1951 found the backlog to be three billion dollars more than it was in 1949. This means that our deficit in construction is growing at the annual rate of $1½ billion. To come abreast of its needs, it is calculated that New York State alone should spend about $200 million annually for the next ten years and $175 million in each of the following ten years—a total of $3¾ billion.

The problem concerns everybody because good highways benefit all and poor ones hurt all. About 59 million Americans ride in motor cars every day. In rural areas people use them for nine out of ten miles traveled, and in cities the proportion is one-half. Ten percent of the average family's outlay for living requirements goes towards financing and operating an automobile. Buses carry more passengers between cities than do railroads, and seven million students ride school buses. Local bus lines have 10 billion passengers a year.

Aside from the motoring people do, they are largely dependent on roads for the things they eat, wear and utilize. Trucks play a part in transporting most raw materials to our factories, in delivering their products and the produce of farms to retail outlets, and in distributing them to the ultimate consumers.

Approximately 53 million automotive vehicles use the highways and streets, and authorities predict there will be 80 million of them by 1975. The problem is becoming more serious all the while, and in all probability it will not be solved until the agencies involved in roadbuilding and maintenance agree upon a long-range program. Once this is done, means of financing it must be found. That should not be too hard, however, because everyone is willing to pay to drive or ride on good highways, as is evidenced by the fact that traffic on all the toll roads opened in recent years has far exceeded expectations.

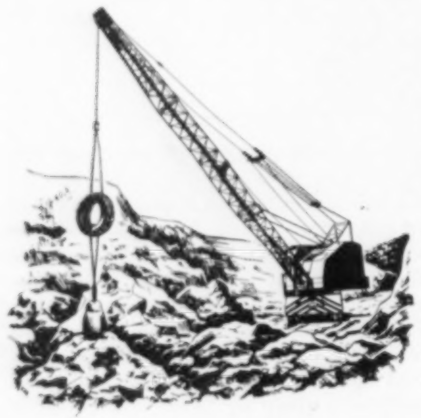
One thing that is necessary is to decide on maximum loads for vehicles and to make certain they are not exceeded. E. W. Kilpatrick, chief engineer of the New Jersey State Highway Department, recently told delegates to the American Trucking Association convention that the frequent passage of heavy loads per axle is the principal cause of road deterioration in his state, which is claimed to have the heaviest truck traffic per mile in the nation. He pointed out that most of the highways were built prior to 1939 and were not designed to withstand the heavy burdens now placed on them. New Jersey is endeavoring to restrict single axle loads to 22,400 pounds and tandem axle loads to 32,000 pounds. Actually, a 5-axle vehicle with a gross load of 103,600 pounds has been found on the highways.

The problem is naturally of vital concern to automobile manufacturers. In an effort to assist those who must cope with the matter and thus, incidentally, to safeguard its own future, General Motors Corporation recently offered prizes totaling $196,000 for the best suggestions on planning and financing a safe and adequate highway network.

# This and That

**Simple Shock Absorber**

Headache ball is the appropriate name applied in the construction industry to the falling weight that is used, under some conditions, to reduce large boulders to sizes that can be readily handled and also to break up sidewalks and pavements. The cable by which the ball is suspended from a crane boom snaps back sharply when the descending ball strikes home and is suddenly relieved of its load. This backlash often causes the cable to slap against the boom or to cut into the sheave over which it passes. The result is fast wear on the wire.



A simple way of overcoming this line shock was devised by Geo. M. Brewster & Son, Inc., of Bogota, N. J., while excavating for a truck access road through a rock ledge in Palisades Interstate Parkway in New Jersey. A headache ball was being used because heavy nearby traffic limited blasting. An old truck-tire carcass was interposed in the line from the crane, thus giving it just enough stretch to absorb the sudden shocks imposed and lengthening its life.

* * *

**Carbon Dioxide Coolant**

Our article on the Cadillac Tank Plant (page 9) cannot, in the space alloted it, cover more than the high spots of the operations involved. Not mentioned is an interesting fact we picked up from the August 14, 1952, issue of *Iron Age*. This has to do with the use of carbon dioxide as a coolant in tool grinding and sharpening. In liquid form, the carbon dioxide is directed onto the work through orifices ranging in size from 0.006 inch upwards. In changing into solid form (dry ice) and then into gas, it absorbs the heat generated by the action of the tool. Advantages claimed for the coolant as compared with other kinds include cleaner grinding conditions, ease of handling carbide tools at the reduced temperature, and elimination of the coolant-disposal problem. A monetary saving is also reported through faster and better grinding and less cracking of tools handled.

* * *

**Soda Water Tonic**

Evidence has been accumulating for several years to support the theory that the use of "soda water" will increase the yield of oil from old formations worked by the water-flooding method. Oil-industry technical men who recently met at Pennsylvania State College heard papers describing the laboratory successes achieved with it by the Pennsylvania Grade Crude Oil Association. The tests indicate that, on an average, 31.7 percent of the oil remaining in place after flooding of the host formation with water alone can be recovered by reflooding with carbonated water. The experiments also reveal that fresh water will hold more carbon dioxide (5.5 percent) than will brine (4.24 percent) and is therefore more effective. To insure fully carbonated water, the gas must be introduced while under a pressure of 720 psi. In an effort to corroborate the laboratory results, a full-scale field trial will be made soon.

* * *

**Stockholm Opens New Subway**

On October 26, Stockholm, Sweden, inaugurated an 8½-mile-long stretch of rapid-transit railway that cost $45 million and was underway for seven years. It is the second in a system that was begun in 1933. The two sections are not interconnected, but will be joined in 1956 by construction now in progress.

About 2½ miles of the line just opened is underground, and approximately one-third of that stretch was tunneled through rock, entailing the removal of five million cubic yards. The open-cut sections were built by first erecting concrete boundary walls at each side and bridging them over so that traffic could move as usual while excavation was proceeding underneath. Some structures had to be underpinned, and the fine gravel and sand on which the Concert Hall rests was consolidated by injecting a mixture of water glass and calcium chloride.

For the present, 6-car trains will serve each of the seventeen stations every four minutes. When the system is fully utilized, trains will be made up of eight cars and will run on a 90-second schedule. Although built in Sweden, the cars are identical with the newer ones in use in New York City. Each of the four pairs of wheels is driven by a 108-hp motor, and trains will have a top speed of 42 miles an hour. Current is transmitted by a third rail. Three double doors in each car are opened and closed by air power. Stations are 480 feet long and designed for emergency use as air-raid shelters, with seats and benches for 1000 persons in each one.

Traffic is supervised from a midway point, where a switchboard controls 75 switches and 150 speed signals and the positions of all trains are shown on a panel. Electrical impulses sent through the rails register on a signal board in the motorman's cab. When an "H" appears, top speed is permissible, while an "M" indicates medium speed, an "L" low speed and the letter "S" calls for a stop. If the stipulated speed is exceeded, a buzzer warns the motorman, and if he fails to slow down in a few seconds, emergency brakes are applied automatically.

* * *

**Unique Flapjack Derby**

While in Liberal, Kans., working on the Northern Natural Gas Company article that appears elsewhere in this issue, we heard of an unusual sports event—the International Pancake Derby. This contest is rooted in a centuries-old tradition. On the day before Ash Wednesday, which signalizes the beginning of Lent, it was customary in Old England for housewives to drop whatever they were doing and hurry to church at the tolling of the bell to be "shriven" of their sins.

In the year 1445, so the story goes, a woman in Olney was in the midst of frying pancakes when the bell sounded. Picking up the griddle, with the cakes still on it, she ran through the streets. From this incident evolved an annual race, which is run over a 415-yard course, equivalent to the original distance, with each contestant carrying a griddle and cakes.

Word of this rather zany Shrove Tuesday competition didn't get to Liberal until 1950, but the idea appealed to the wheat-growing community, which advertises itself as the "Pancake Hub of the Universe." A challenge was promptly hurled across the Atlantic, and as promptly accepted by the Rev. R. C. Collins, vicar of Olney. In consequence, housewives of Liberal and Olney now race against each other every year on a time basis, with communication maintained by transatlantic telephone.

THE WINNER
Mrs. Farice Bruce, Jr., leading field at Liberal in 1952.

Liberal makes a big thing of the day. It is arranged by the Junior Chamber of Commerce, and plans are started weeks in advance, while the younger women practice diligently for the main event by dashing through the streets with griddles extended. The approved uniform is a house dress and apron.

Last year the day was February 26, and the program began at 6:45 in the morning with a joint breakfast of all the civic clubs. At 10 a.m. there was a parade, and the race got off at 11:55. Eighteen housewives lined up for the starting signal. The fleetest flapjack flipper was Mrs. Farice Bruce, Jr.

A beauty contest, basketball game and free movies for the kids were scheduled for the afternoon. An amateur talent hour ushered in the evening festivities, with special entertainment by Pete Welborn, who gained local fame by composing the "Pancake Song." A dance concluded the affair. Pancakes were served throughout the day and, for international flavor, there was an exhibit from the British Isles.

While somewhat of a carnival atmosphere prevails in Liberal, the British still attach considerable religious significance to the event. The race is started by a church official, with the vicar in attendance, and is given church sanction by the biblical quotation from St. Paul's Epistle to the Corinthians, "They who run a race, run all, but one receiveth the prize." One of the prizes, incidentally, is a traditional kiss planted on the winner's cheek by the verger of the church.

★ ★ ★

**Huge Mine Blast**

An underground blast that brought down approximately 400,000 tons of ore was set off in the Frood-Stobie Mine of The International Nickel Company at Copper Cliff, Canada, in November. It was one of the largest subsurface shots on record, and someone figured out that the broken material would fill a train of freight cars 14 miles long. The blast was fired in connection with the current conversion from open-pit to underground mining.

Four large stopes were driven upward from the 600-foot level to the floor of the pit and two large pillars of ore were left as supports while the stopes were being mined. The pillars were removed in two stages: the top halves were shot down sometime ago and the bottom halves, which were 200 feet long, 70 feet wide and 150 feet high, were broken up by the blast referred to. Lodging places for the 64 tons of explosives used were provided by drilling 2000 holes from 42 to 110 feet long and having an aggregate length of 165,290 feet (31 miles). Plans are being made for an even bigger blast.

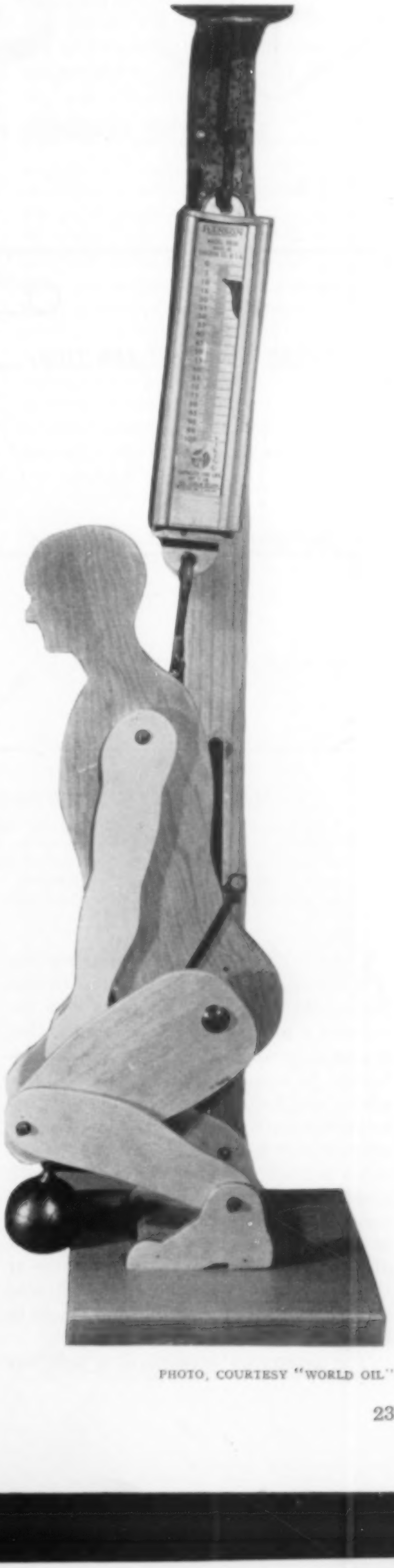
## Samson the Safety Demonstrator

THE loss of 107 working days in one 6-month period through back injuries prompted Safety Supervisor Holley Bradley of the Service Pipe Line Company, Tulsa, Okla., to build Samson so that he could convincingly show the workers how heavy weights should and should not be lifted. Lifting, it is claimed, is the cause of most industrial and domestic back injuries primarily because the body is not in proper position.

Samson is a wooden man 36 inches tall and weighing 4 pounds. He has jointed arms and legs and carries a scale on his back to measure the strains induced when lifting a load. His sole function in life is to lift a 4-pound steel ball in the approved and disapproved fashion. For purposes of demonstration, Bradley attaches the scale to Samson's shoulders and the weight to his hands and then, with the body in the correct position with legs bent, makes him lift the ball by straightening the legs. Under these conditions the scale registers 8 pounds—4 to raise the man and 4 to raise the load.

Next, the scales are hooked to the small of of Samson's back to show what happens when he lifts the weight with his back muscles, the incorrect way. But before putting the wooden man through his paces, Bradley calls for guesses as to the amount of strain the scale will register. Guesses usually range between 20 and 100 pounds; but the strain indicated is 56 pounds, or 48 pounds of muscular effort expended unnecessarily and, maybe, harmfully.

Samson serves another function, Bradley claims. As an attention-getter at the company's safety exhibits, he is invaluable and tends to loosen up the men and start them asking questions concerning other safety precautions. In the interest of safety, Bradley has offered the use of his idea to companies that have to contend with back injuries caused by lifting.



SHOWS THEM HOW
Dubbed Samson or Hercules, this wooden man is used to teach men to lift heavy loads without straining their backs. He is made of plywood and pictured here in the correct lifting position with legs bent. The scale fastened to his shoulders is calibrated in pounds from zero to 100 and indicates a pull of 8 pounds when lifting a 4-pound steel ball with his legs and 56 pounds when strain is put on his back.

PHOTO, COURTESY "WORLD OIL"

# Pneumatic Tide Generator

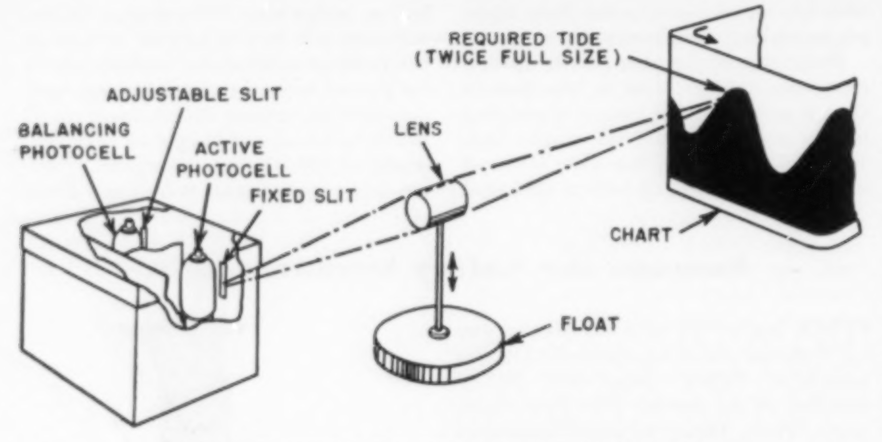
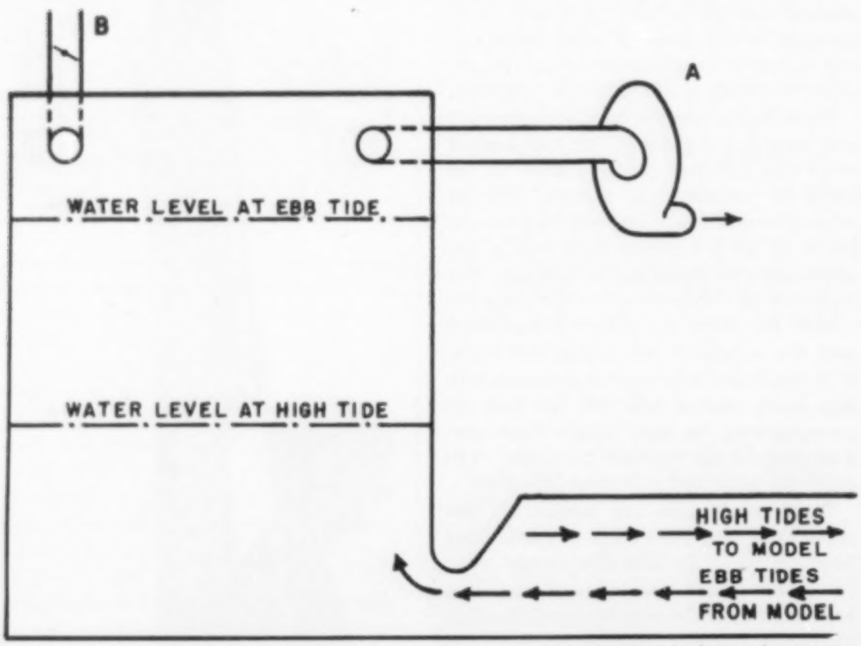


CHART UNIT DESIGNED FOR THAMES RIVER MODEL



COURTESY, THE (LONDON) ENGINEER

DIAGRAMMATIC ARRANGEMENT OF THE TIDE BOX

When in service, air is continually exhausted from the box by fan "A" while butterfly valve "B" controls the water level. When it is open, air enters the inverted chamber, causing the level of the water in the box to drop and that in the estuary model to rise, and vice versa. The valve is operated automatically by a servomotor controlled by the chart unit.

AS PART of a research program, the Engineering Division of the British National Physical Laboratory has developed a pneumatic tide generator that is said to overcome the disadvantages inherent in conventional mechanical-displacer and hydraulic types generally depended upon to solve problems in connection with harbors, river estuaries and other seaboard areas. It is used with scale models of estuaries and the like and controlled automatically. Three are now in operation in conjunction with models of the River Wyre and Thames, one at the Teddington Tidal Model Basin and the others at the Royal Victoria Docks in London.

The generator consists of a tide box with an inverted chamber at the seaward end of the model. It is made of wood or concrete in varying dimensions, depending upon the model (that for one of the Thames models is of reinforced concrete and measures 40x12x6 feet). Except for a fan, which is installed outside of the structure housing the equipment, the tide box supports all the other components, including a chart unit, a motor unit and a control unit.

When in service, air is continually exhausted from the tide box by the fan, while an accurately controlled volume of air is allowed to enter the inverted chamber by opening a motor-operated butterfly valve. This regulates the air pressure in the box and controls the amount of water drawn from or admitted into the model—in other words, the water level. The chamber extends to the floor except on the side flanking the model, where it is an inch or two beneath low-water level. It is through this gap that the water flows between the tide box and the model.

Two chart units have been designed to cope with tidal amplitudes ranging from 1 to 7¼ inches. They are made up of the chart on which the desired tide curve is drawn, its driving mechanism, a cylindrical lens mounted on a support which floats on the surface of the water in the model, two photoelectric cells, lamps and a preamplifier. The chart moves at constant speed past the photoelectric detector, and as it does so the desired water level is compared with the actual level as given by the float in the model. Any error in magnitude results in a proportional voltage, which is amplified and causes the motor to operate the butterfly valve through a gearbox and cam.

Numerous advantages are claimed for the "air plunger" tide generator over earlier types. These include simplicity of construction through the elimination of heavy moving parts; reduction in power consumption; and flexibility which permits a wide variation in amplitude, shape and period of tides.

## Steel-Strip Width Gauge

A NEW noncontacting device which continuously and automatically measures the width of hot strip steel within an accuracy of ⅛inch plus or minus has been announced by the Special Products Section of General Electric Company. Called the steel-mill width gauge, it is said to be the first of its kind ever developed and is expected to become one of the industry's basic tools.

The equipment consists of a detector head, an operator's cabinet and an electronic cabinet. Two phototube scanners, located in the gasket-sealed head, pick up the light radiated from the hot strip and convert it into electrical signals—two pulsating square-waves. These are amplified, added together, and the total is balanced against a standard voltage, the difference between the two producing a signal proportional to the width deviation. The detector head is mounted 15 feet above the strip, where it is safe from scale, severe heat and corrosive fumes.

It is claimed that widths of 10 to 96 inches can thus be measured at temperatures of 1350-2050°F and indicated in less than one second after the strip has passed under the detector head. Strip position can vary as much as 3 inches either vertically or horizontally without affecting gauge accuracy, and no changes in the mill or mill table are required.

# Lightweight Aggregate of Exceptional Fineness

BY THE use of a radically new aggregate, contractors will be able for the first time to fill forms with concrete pumped through rubber instead of metal hose or pipe. This announcement was made recently by a ceramics expert of Armour Research Foundation, Illinois Institute of Technology. The material consists of tiny glass balloons made by blowing up individual grains of clay in a vertical furnace that was designed by the Foundation after four years of laboratory work sponsored by Kanium Corporation organized by a group of industrialists for the purpose of developing new building materials.

The clay is ground and screened and fed into the top of the tall furnace. In their descent through an air-gas flame of approximately 2700°F, the particles melt and give off gases that inflate them—convert them into hollow spheres that are cool when they reach the bottom. The bubbles vary in diameter from 0.0024 to 3/16 inch, depending upon the raw material and the method of processing; those from 0.0106 to 0.0069 inch in size seem to have the widest field of application. (The familiar expanded aggregates are 3/16 inch in diameter and up.)

Used instead of sand or other aggregate, Kanamite, as the material is tradenamed, gives a concrete mix of high fluidity even with a low water content. This explains why it can be delivered to the point of placement by rubber hose. In addition, the light-weight aggregate is suitable for making mortar, plaster, refractories and high-temperature insulation, and also serves as a filler in plastics and roadbuilding materials.

The Foundation became interested in the project in 1948 when J.D. McLaughlin, now president of Kanium Corporation, approached it with a few of the tiny granules which he had processed experimentally. Could they be produced on a commercial scale, he wanted to know. The upshot was that the Ceramics and Minerals Department started a research program and set out to develop a furnace after it was determined that the material had potential value. By December, 1951, several successful pilot furnaces using air and city gas had been built. Today, Kanamite is being turned out in a plant in Blue Island, Ill., which also serves as an extension of the Foundation's laboratories for the continued improvement of the product.

# Drives Twenty Nails a Minute

A SIMPLE attachment that will convert a small pneumatic hammer into a power nailer is manufactured by Nelson Equipment Company, of Seattle, Wash. It will drive nails or spikes much faster than they can be hammered in by hand and with far less muscular exertion. One advantage of the assembly over some other types of power nailers is its lightness, which permits holding it overhead for driving nails upward. Models are available to fit hammers of various sizes, the largest being suitable for boat spikes up to 3/8 inch in diameter and 8 inches long.

EASES OVERHEAD WORK

The Fox Nailer attachment for a pneumatic chipping hammer starts a nail and drives it flush with the surface or slightly countersinks it. An operator holding the tool in one hand and several nails in the other can insert them in the attachment as fast as he drives them.

Called the Fox Nailer, the unit has been used on numerous West Coast construction jobs. At Richland, Wash., in fastening heavy furring strips to ceiling joists in a school building, it drove 16-penny nails at a rate five times faster than hand hammers could do the work. In erecting prefabricated structures at Fort Lewis, Wash., one of the nailers hammered hardened screw nails through aluminum ribs, with a pneumatic screw driver completing the operation.

The inventor of the device, Malcolm H. Fox, explains that he first began thinking about it in 1925. Contractors in northern New Jersey, to whom he was then selling radial arm saws, suggested that a useful adjunct would be a tool for nailing material in place after it was sawed. The matter was brought to his mind again a few years ago in the Seattle district where numerous schools were being built.

Insulation, placed between ceiling joists and 2x2-inch furring strips, had to be nailed at right angles to the joists with 16-penny nails to hold the plaster lath or acoustical tile. Fatigued by the great amount of overhead nailing that was entailed, many carpenters left the jobs, and serious cost and turnover problems resulted. Devised to meet this situation, the Fox Nailer soon became popular locally for work overhead or in hard-to-reach places. The first 100 units have been in service about two years, and it is now planned to market the nailer nationally.

The attachment consists of four parts, only two of which are movable, and requires no lubrication. It fits any pneumatic hammer having a No. 2 Parker or Morse taper or using a .401 round shank. It will drive twenty 16-penny nails a minute with approximately 8 cfm of compressed air. On a Pacific Northwest construction job, one unit drove more than 1½ million nails without failing. Because it is almost impossible to bend a nail with the device, it is claimed that the saving in nails effected by it will more than pay for it.

FILE CASE FOR BIG SHEETS

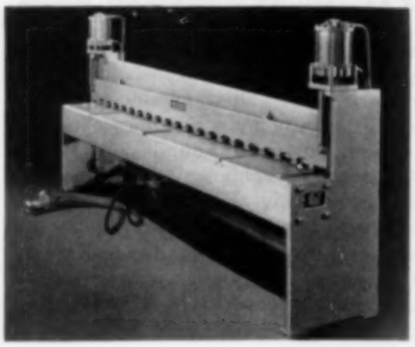
This cabinet will hold your blueprints, drawings, tracings, maps and the like neatly and enable you to file them easily by opening the front panel or to take out any one without disturbing the others. Each hangs freely from suspension rods by attachable manila hangers and is located by an indexing system. Aluminum hangers for group filing also are available and will accommodate up to 50 related drawings. Called Draw-In-Dex, the cabinet is made in two sizes—48 inches high, 20 inches deep and 30 or 39 inches wide—by the Empire Development Corporation, Huntsville, Ala. Each takes 1250 prints.

# Industrial Notes

To help the maintenance man, the Anco Instrument Division is making an electronic stethoscope, the Elec-Detec, that enables them to locate the source of friction noises in bearings, pistons, gears, ratchets, cams, clutches and other parts quickly and surely, it is claimed. The instrument has a metal probe that serves as a microphone, and sound impulses are transmitted through an amplifier to headphones. Volume and sensitivity are controlled by adjusting knobs on the leather carrying case. The probe can be fitted with short or long, straight or curved metal rods to meet varying requirements. Noises that would normally be heard only at high speed can be detected at low speed, even when a machine is turned by hand, says the manufacturer.

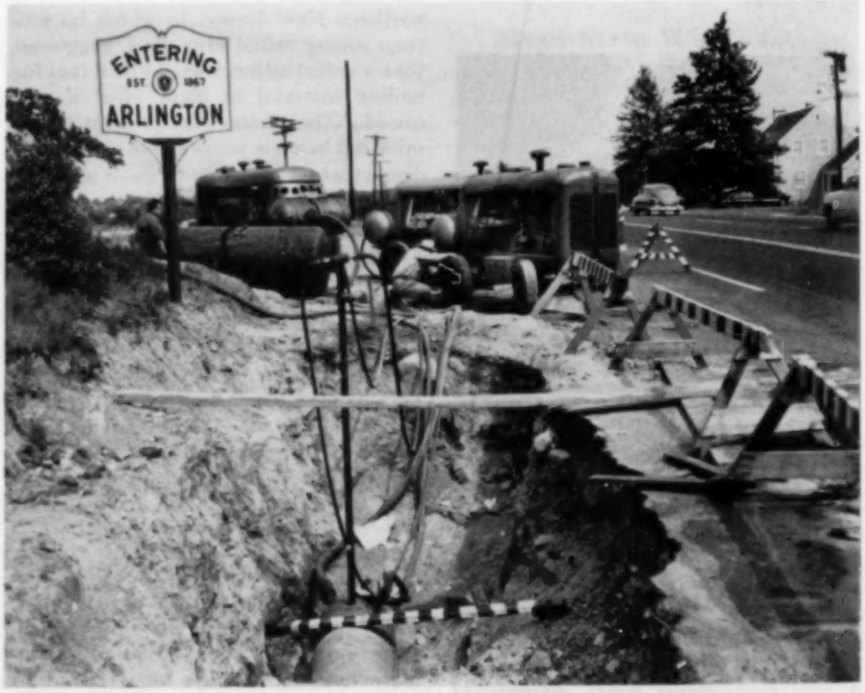
High resistance to breakdown is one of numerous characteristics claimed by Shell Oil Company for its Alvania Grease and attributed to the lithium 12-hydroxy stearate base. Described as a multipurpose compound that was subjected to more than a million strokes in an A.S.T.M. motorized worker test without loss of body, the product also is said to be exceptional for its high water tolerance (maintained its lubricating qualities with 32.5 percent water present), its broad temperature range and high melting point, good pumpability, storage stability, etc. Because of this combination of properties, according to a company announcement, relubrication periods for bearings can be substantially lengthened and the grease can take the place of as many as twenty different compounds.

Some years ago it was discovered that considerable savings in paint could be effected by allowing the coating materials to pass through an electrified field created by charged grids. Today, by means of equipment recently announced by Scientific Electric, manufacturer of high-frequency and high-voltage equipment, the paint is charged before not after it leaves the spray nozzle. According to the maker, the older method is efficient for coating flat surfaces, while paint applied with the new Ionic Gun penetrates cavities and crevices as well. The unit includes an ionic high-potential power supply and control, also lately developed by Scientific Electric and available in an 80-140 kvp range. The gun is designed for use with a wide variety of adapters suitable for well-nigh any commercial or industrial application. Paint savings of more than 60 percent are reported, compared with conventional methods.



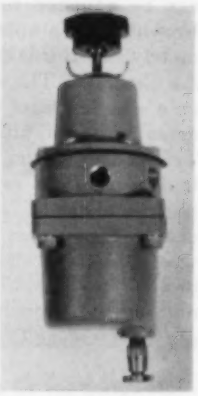
By using compressed air to power its new squaring shears for sheet metal, Niagara Machine & Tool Works has greatly simplified construction and, incidentally, operation and maintenance. There are two types: one for cutting 16-gauge stock into 3-, 4-, and 6-foot lengths and the other for shearing 18-gauge material into 8- and 10-foot lengths. The latter models are equipped with two pneumatic cylinders (as shown) and the smaller sizes with one mounted beneath the bed. Depressing a foot valve automatically clamps the hold-down and lowers the crosshead to make the cut; release of the pedal returns both to the starting position. Air at 70-80 psi serves to actuate the cylinders and may be taken from a shop line or supplied by a 2- or 3-hp compressor provided with a surge tank.

To its list of standard products, the Industrial Division of Minneapolis-Honeywell Regulator Company has added a combination pressure regulator and filter that reduces air-line pressure up to 150 psi, maintains any set output pressure from 0 to 35 psi, and provides air-operated instruments and similar devices with clean air. The unit works on the pneumatic-balance principle like



**A PIG IN A PIPE**

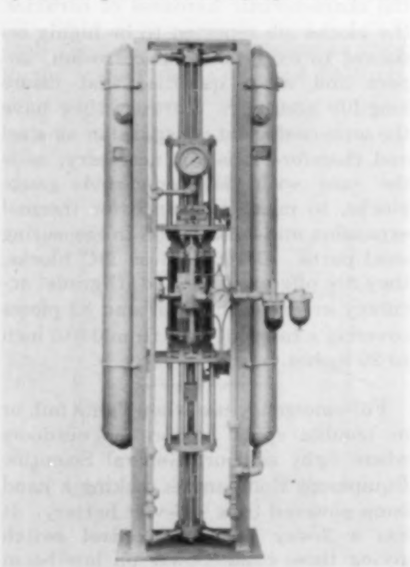
Somewhere in the pipe that ends in the trench in the foreground is a 35-pound mechanical "pig." A cylindrical object, encircled with wire brushes and a rubber shield that gives it a close fit, it cleans the line of rust, scale and dirt as it is pushed along by compressed air. The scene is between Cambridge and Lexington, Mass., on the Concord Turnpike. The main, a 30-inch natural-gas carrier, was being laid for the Algonquin Gas Transmission Company by Hallen Company, Inc., of Long Island City, N.Y. In this case, the "run" of the pig was about one mile. To insure an ample supply of "wind" for its journey, three Ingersoll-Rand portable compressors, two of 315-cfm capacity and one of 500-cfm, were kept at work with the receiver shown at the left providing additional air.



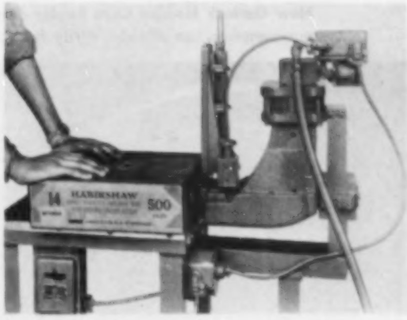
an earlier model, but differs from it inasmuch as it is built to minimize air consumption and undesirable buzzing. The filter element is a self-contained cylinder of helically wound ribbons of phenolic resin-impregnated cellulose that is said to remove particles of oil, water and solids as small as 40 microns. It is housed in an end cap that serves as a dripwell and can be cleaned by dipping in a solvent such as gasoline or, if practicable, by reverse air-flushing. The regulator-filter is suitable for pipe-line or flush panel mounting.

For heavy-duty service, especially where high temperatures are involved, Beauideal, Inc., is making a bimetallic bearing that combines lightness with strength. Those of Nitralloy steel and highly leaded bronze resist temperatures of 1100-1200°F, while those with a face of long-grain bronze can be heated to 1500-1600°. The light, bronze bearing surface reduces the possibility of extrusion under heavy loads. The bond between the steel backing and bronze cannot be broken, it is claimed. A large range of sizes is available to meet specific applications.

Ledeen Manufacturing Company has announced a new series of heavy-duty, air-hydraulic pumps and power units that are designed to develop high fluid pressure from low air pressure taken directly from a plant's air supply. They are suitable for operating high-pressure cylinders, clamps, valves, actuators and hydraulic presses; for high-pressure testing; for hydraulic circuits requiring variable and adjustable pressure and volume; and for long pressure-holding cycles with quick approach without overheating or churning the hydraulic fluid. Both pressure and volume are readily adjustable. Unit comes in a complete package ready for installation and is available in horizontal or vertical construction.



An improved stapling machine of the retractable anvil type for closing filled corrugated or fiber cartons has been announced by the International Staple & Machine Company. The new model is operated with air at 60 psi and functions automatically when the box is pressed against the stapling head. It is designed for closing overlap cases and for the end closure of long, narrow containers of the overlap or slotted type. Stapling is done from the outside, but the equipment

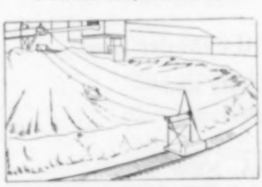


ONE OPERATOR... can DIG... HAUL... DUMP...

Picture shows a 2 cu. yd. Sauerman Power Scraper with a 500 ft. operating span used by the Nevada Silica Sands, Inc., to mine sandstone. Because the material will not cave, the digging path of the scraper must be changed frequently, so the tail end is arranged for automatic rapid shifting.

MORE YARDS with a SAUERMAN *Long Range* MACHINE

Sauerman Scraper Excavator



Sauerman Scraper Stockpiler

Sauerman Slackline Cableway

"The best bet for big output and low upkeep on any dig-and-haul job," say users all over the world, "and Sauerman machines are simpler to operate, which holds expense down."

Yes, Sauerman machines feature speedy, trouble-free action under the control of a single operator . . . move large yardages from any point within their cable radii. Sauerman machines will reach across a river, deep down into a pit, up to the top of a hill or across a wide stockpile—and handle a heaping load every time. Digging, hauling and dumping are accomplished in one continuous rapid cycle.

Other features of Sauerman Slackline Cableways and Power Drag Scrapers: First cost is low . . . maintenance is negligible . . . flexibility of the machines means they can be extended readily and adapted to suit changing requirements.

Write for catalog and full details.

**SAUERMAN BROS., Inc.**
548 S. Clinton St. Chicago 7, Illinois

Cableway and Scraper Specialists Since 1909

**New Garlock Molded Cups Folder describes in detail our complete line of cups. Write for your copy today!**

Garlock Molded Cups

## GARLOCK MOLDED CUPS

### For Pump Pistons—
### Hydraulic Service—
### Pneumatic Equipment

**A COMPLETE LINE OF CUPS FOR INDUSTRIAL USE**

Garlock Molded Packing Cups are made from the highest grade materials to rigid specifications for *long, trouble-free service*. These cups are made in many types and styles, each designed and constructed for a specific service condition.

**BITAN* Leather Cups,** available for practically any cylinder diameter size, are recommended for use against cold and hot water, oils, gases, and solvents. For hot oil service up to 250°F., specify synthetic-rubber-impregnated Bitan leather cups.

**Rubber and Synthetic Rubber Cups with fabric insertion** are made in a wide range of material combinations for cylinder diameters from less than ½" up to and including 16". For service against air at high or low pressures, against oils, and on heavy duty hydraulic equipment.

**Cups for Pump Pistons** are available for standard cylinder sizes.

*Start cutting maintenance and replacement costs now—standardize on Garlock Molded Cups.*

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

*Registered Trademark

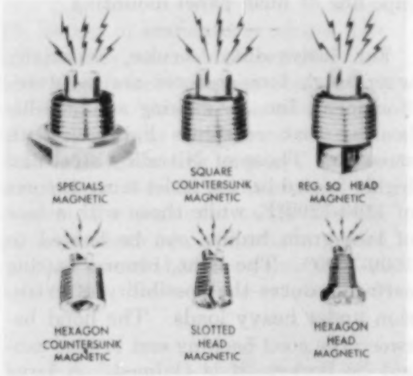
GARLOCK

**PACKINGS, GASKETS, OIL SEALS,**
**MECHANICAL SEALS, RUBBER EXPANSION JOINTS**

can be adjusted for concealed stapling by which the staples penetrate approximately two-thirds of the carton wall and are clinched. The assembly is mounted on a stainless-steel table that accommodates boxes of different sizes. Model TH1-HAS, as the pneumatic machine is designated, is said to work fast and also economically because it makes firm, neat closures with few staples per unit area. Cartons closed by this method meet Consolidated Freight Classification requirements and have the approval of the Post Office Department.

---

Designed for all makes of cars, Magnetic Drain Plug Company is offering pipe, drain and filler plugs in standard and special styles of varying metals in sizes ranging from ⅛ inch to 2 inches. Magnets are of the permanent Alnico type that are sufficiently powerful to attract more than ten times their weight in abrasive ferrous particles directly from the oil or lubricant stream—not only those that normally settle, says the maker. All plugs are threaded "Dryseal" to prevent leakage.



---

Gauge blocks are being made by The DoAll Company of chromium carbide, a new material that is said to be ideal for the purpose. In addition to possessing the characteristic hardness of carbides, the blocks are reported to be highly resistant to oxidation and corrosion, impact and wear, qualities that insure long-life accuracy. Further, they have the same coefficient of expansion as steel and therefore it is not necessary, as is the case with tungsten-carbide gauge blocks, to make allowance for thermal expansion and contraction in measuring steel parts. Designated as DC blocks, they are offered in A- and B-grade accuracy in sets of 8, 35, 37 and 83 pieces covering a range of sizes from 0.010 inch to 20 inches.

---

For emergency use when lights fail, or in trouble spots indoors or outdoors where light is poor, General Scientific Equipment Company is making a hand lamp powered by a 7½-volt battery. It has a 2-way fingertip control switch giving three candlepower on low beam

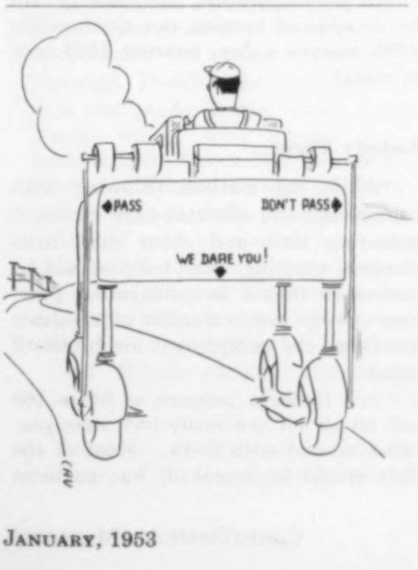
and 21 on high beam. It is provided with a 6-inch adjustable head with reflector, and a rubber grip handle makes it easy to carry. The lamp is designated as GS Model 22.

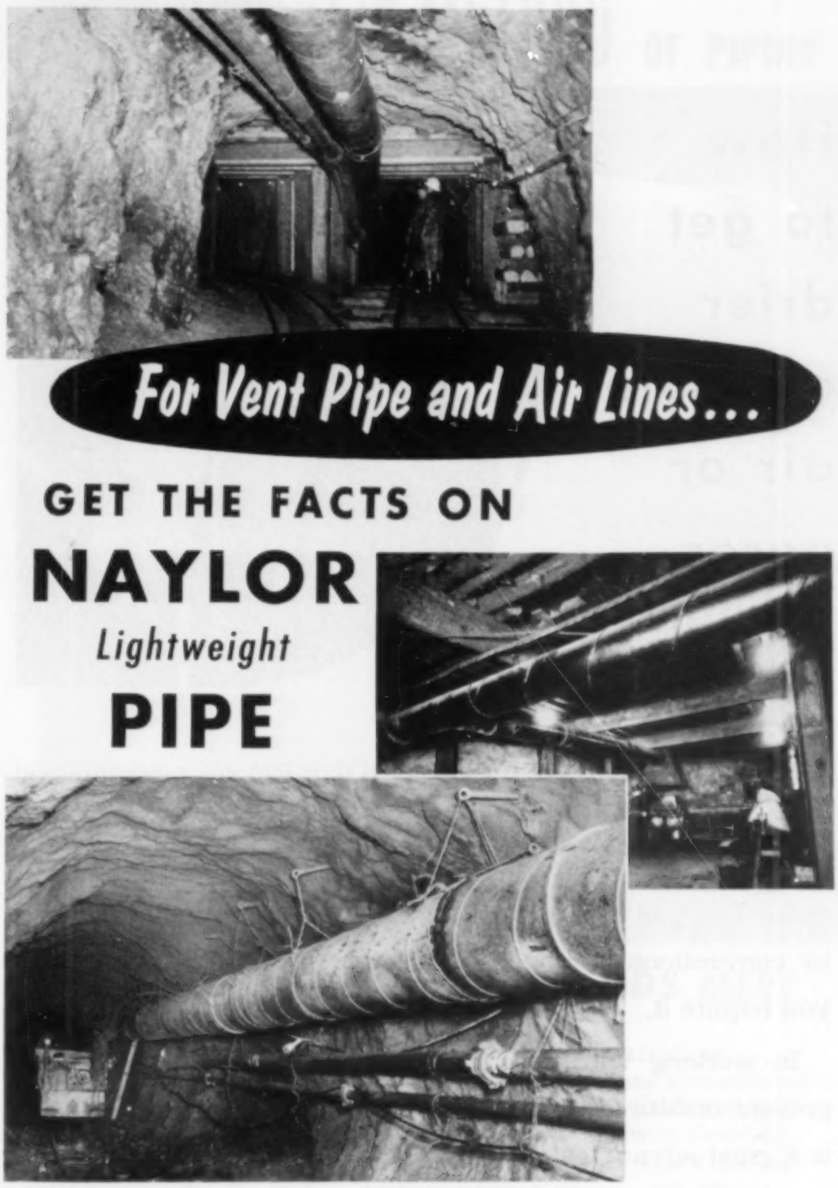
---

Sulphur, a strategic material in short supply, is being recovered from sour gas by the Stanolind Oil & Gas Company at the Elk Basin, Wyo., gasoline plant. The gas obtained there contains an excess of hydrogen sulphide which generally is vented to the atmosphere and flared. At Elk Basin, however, it is extracted by a modification of the recently developed Claus process. The plant is equipped to treat daily twelve million standard cubic feet of casinghead gas, which yields 13,400 gallons of gasoline, 13,500 gallons of butane, 12,000 gallons of propane and, among other by-products, 40 long tons of commercial sulphur.

---

Clogging and "blinding" of screen cloth used in sizing or processing wet bulk materials is prevented, it is claimed, by a new electrical heating system announced by Hewitt-Robins Incorporated. By the older method, current is passed through steel or copper skirtboards alongside and above the screen, but by the new arrangement it is carried by short insulated cables attached to copper bars which are under the screen and make direct contact with it. Wet coal, clay, stone, etc., tending to cling to the heated cloth, dry and flake off,





For Vent Pipe and Air Lines...

GET THE FACTS ON

NAYLOR

Lightweight

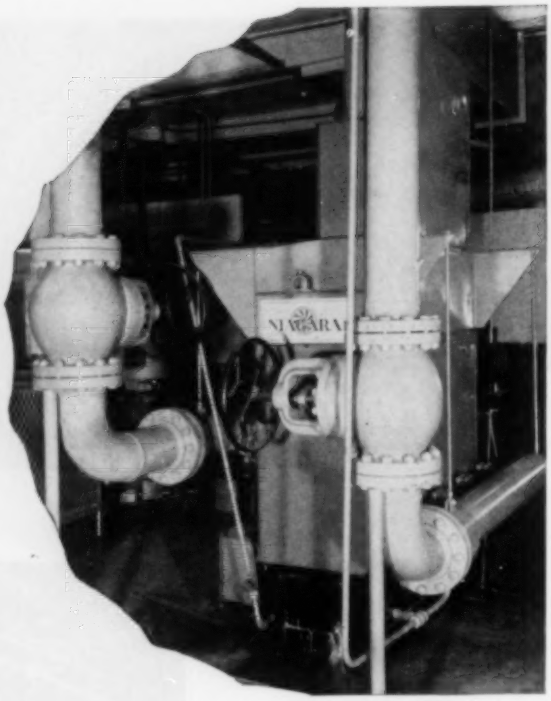
PIPE

Naylor is the one lightweight pipe with the built-in strength and safety required for push-pull ventilating as well as pressure air lines in mining service. It's easy to handle and install, especially with Naylor's Wedge-Lock coupling. It's extra strong because the Naylor Lockseam Spiralweld structure provides a distinctive reinforcing truss which adds collapse strength necessary for push-pull service. Naylor pipe comes in sizes from 4 to 30 inches in diameter.

*For full details, write for Bulletins No. 507, No. 513, and No. 514.*

**NAYLOR PIPE**

**NAYLOR PIPE COMPANY**
1245 East 92nd Street, Chicago 19, Illinois
*New York Office: 350 Madison Avenue, New York 17, New York*



**How to get drier or cooler air or gases . . .**

**NIAGARA AERO AFTER COOLER** cools a compressed gas, or air, below the temperature of the surrounding atmosphere, thus preventing the condensation of moisture in your lines. The gas will contain only half of the moisture left in it by conventional methods. Even drier gas can be produced if you require it.

In working with controlled atmospheres of inert gases to prevent undesired reactions, this dryness of the gas at low cost is a great advantage. The cost of the Niagara method is low because it uses evaporative cooling, saving 95% of the cost of cooling water (and its piping and pumping). This direct saving of cost pays for the Niagara cooler in less than two years.

If you use compressed air to operate tools or pneumatic equipment you save much in water and oil damage to tools and equipment, and in water damage to materials by using the Niagara Aero After Cooler.

Write for a bulletin, or ask nearest Niagara Field Engineer if you have a problem involving the industrial use of air.

**NIAGARA BLOWER COMPANY**

Over 35 Years' Service in Industrial Air Engineering

**Dept. CA, 405 Lexington Ave.** **New York 17, N. Y.**

*Experienced Field Engineers in Principal Cities of U. S. and Canada*

thus keeping the mesh clean. The distribution bars are protected from the abrasive action of the material, and the screen can be easily replaced when worn.

---

Lignite, a low-grade coal, is being converted into a "powerful" fuel by a process about which no details are divulged. But reports have it that the Aluminum Company of America has decided to use it for power generation at its $80 million smelting plant at Rockdale, Tex. The latter is located in a region rich not only in oil and gas but also in lignite of which a reserve of 150 million tons is available, according to geologists. The plant is to be put in full operation some time this year and will be the first to make practical use of one of our more or less untouched natural resources. In the course of processing, the lignite will yield tar, a profitable by-product.

## QUOTES

*—FROM HERE AND THERE*

### Dream Foundry

Ford Motor Company's new Cleveland foundry is called a dream plant and is the most nearly automatic one ever devised. Of its sand-handling system, the magazine *Steel* says:

"Some 54,000 tons of sand is stored inside after being thoroughly dried as it comes out of railroad cars. The core sand is brought to muller hoppers by conveyor. Prepared core sand is delivered to core blower hoppers by pneumatic tubes, the control panel for this system looking for all the world like a layout of a railroad switching yard. Flashing lights represent mixers, and points of use signal when sand is needed and when bins are full. The sand itself is never seen until the cores are blown and removed from core boxes.

"Among the innovations is the use of heat exchangers to recirculate the hot blast (ordinarily lost up the stacks) through the foundry's ten cupolas.

"In peak operation, the foundry will be capable of turning out castings for 4600 engines a day, pouring 1400 tons of metal."

### Safety First

"While the method (blowing with compressed air) offers an easy means of removing lime and other dust from workers' clothing, everybody should be instructed that it is a dangerous practice. Every year a number of accidents involving the compressed air brush-off occur.

". . . Under a pressure of 80 to 100 psi, an air jet can really kick dust particles around with force. Most of the dust would be removed, but particles could be driven into the pores or land in the eyes and on other sensitive body areas. Skin irritation, burns, the possible loss of an eye are potential accidents a careless employee can expect from using compressed air to clean his clothing."

*From National Lime Association Safety Letter*

### Air Blast Spots Empties

"David Schreiber, plant superintendent at the Buffalo, N. Y., pharmaceutical plant of the Arner Co., has worked out a very simple solution of the problem of 'empties,' that is, cartons accidentally sealed without their intended load of bottled drugs. He installed an air blast directed at the cartons coming off the discharge belt of the automatic sealing machine. Pressure is strong enough to blow off the empty cartons, without disturbing the filled ones."

*Chemical Engineering, August 1952*

### Flushing Drill Holes With Air or Gas

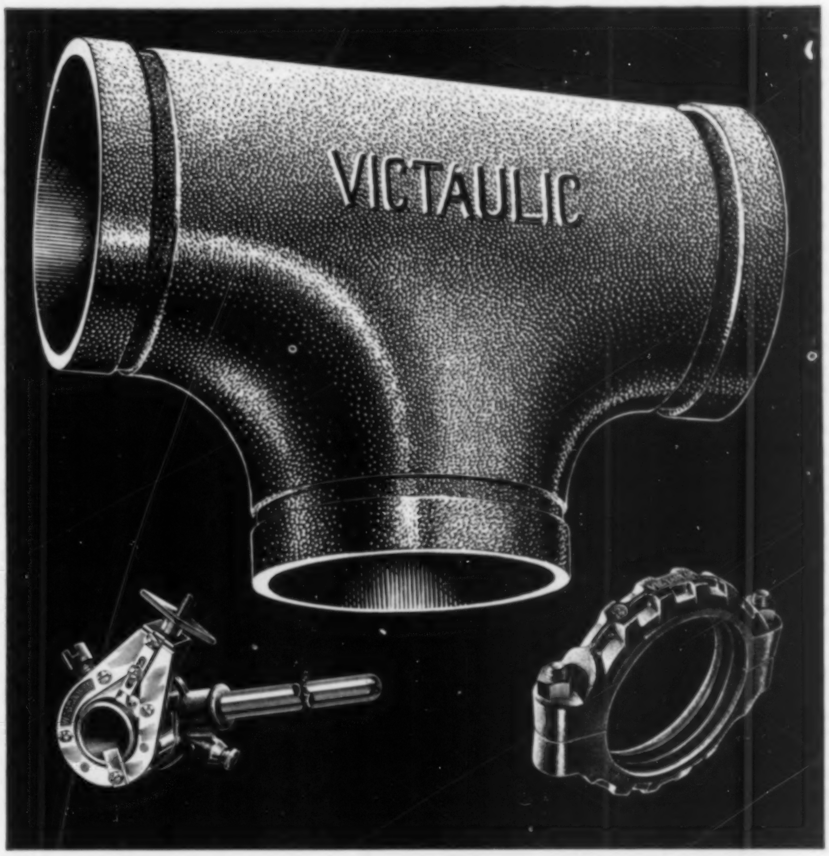
"The rotary method for drilling blast holes in rock quarries was introduced several years ago. Conventional 3-cone oil-field bits were used and weights and rotary speeds were comparable to those used in oil-well drilling. Water was used as the circulating fluid. In 1949 and 1950 the use of compressed air instead of water was introduced. A marked increase in drilling rate and footage resulted. It was also discovered that the bearings and cutter teeth lasted longer.

"Following this, seismograph operators experimented with the use of air in place of drilling mud. Similar performance improvements were noted as long as the holes remained dry. If, however, a water-producing formation was encountered, the cuttings would become gummy and plaster on the walls of the hole, and, at times, completely plug the hole.

"The method has been extended to the drilling of oil and gas wells using either compressed air or natural gas. As long as no fluid-producing formations were encountered the results have been phenomenal. Possibly the most spectacular is a test made in Val Verde County, Texas, where, with natural gas the flushing fluid, 9 rock bits were used in 9 days in drilling a section that had required 43 rock bits in 26 days with conventional mud circulation on a neighboring well. These results appear fantastic, but they are not out of line with improvements experienced in other wells where gas or air drilling has been tried."

*H.B. Woods, assistant director of research engineering, Hughes Tool Company, Houston, Tex., in a talk to the Petroleum Division of A.S.M.E. at Kansas City, Mo., September 22, 1952.*

THE VICTAULIC® METHOD OF PIPING



EASIEST WAY TO MAKE ENDS MEET

"VIC"
VICTAULIC

Sizes ¾" through 60"

VICTAULIC
COMPANY OF AMERICA
P. O. Box 509 • Elizabeth, N. J.
Office and Plant: 1100 Morris Ave. Union, N. J.
Telephone: Elizabeth 4-2141

Copyright 1952, by Victaulic Co. of America.

TEES . . . ELBOWS . . . REDUCERS . . . the Victaulic Method features a complete line of modern, top efficiency, Full-Flow Fittings for use with world famous Victaulic Couplings!

The Victaulic Method assures a complete, modern system of piping . . . fast, efficient hook-ups that simplify and streamline construction . . . cut costs! Victaulic Couplings offer easy-to-install, leak-proof connections . . . a union at every joint . . . assured trouble-free service under pressure or vacuum. Victaulic Full-Flow Fittings specially designed for use with Victaulic Couplings provide wide adaptability and complete versatility in construction. And to make the Victaulic Method complete—"Vic-Groover" Tools groove standard pipe easily and quickly . . . provide handy, portable equipment for preparing pipe right on the job!

Try the VICTAULIC METHOD on your next piping job. New construction . . . repairs . . . alterations—you'll find that the Victaulic Method *is the easiest way to make ends meet!*

Write today for Victaulic Catalog and Engineering Manual No. 44-8B

**28th VICTAULIC YEAR**

**California:** Victaulic Inc., 2330 East 8th St., Los Angeles 21
**Canada:** Victaulic Co. of Canada Ltd., 406 Hopewell Ave., Toronto 10
**Export:** Pipe Couplings, Inc., 30 Rockefeller Plaza, N. Y. 20, N. Y.

## Books and Industrial Literature

A new book, *Roche Estimating Methods*, by W. Earle Roche, construction consultant, sums up in 704 pages the author's 44 years of experience in the field of estimating during which his methods have been applied to construction projects approximating four billion dollars. The volume describes in detail the procedure and method of preparing cost estimates and reports for general engineering and building work. Bound with a flexible cover, the 8½x11-inch pages are arranged in fourteen sections, plus a table of contents and index.

Part 1 deals with Practical Estimating Procedure; part 2, The Construction Industry; part 3, Construction Work Information; part 4, Public and Labor Relations; part 5, Work Investigations and Reports; part 6, Agreements, Schedules, Quantity Surveys; part 7, Work Programs and Progress Graphs; part 8, Construction Materials and Supplies; part 9, Estimating Construction Plant Costs; part 10, Estimating Construction Work Costs; part 11, Estimating General and Indirect Costs; part 12, Summarizing Construction Estimates; part 13, Checking Estimates and Reports; and part 14, Glossary of Construction Terminology. Included is information on profit allowances, write-ups and pricing of competitive proposals for construction work.

Each part is divided into a text section and a section of illustrations, graphs and charts. Handy tables of weights, measures, gauges and strength of materials are available with references as to their use in estimating. Another useful reference is the check list of construction-work items covering all the varied kinds of work that may have to be done or sublet by the estimator's company. Appended is a supplement of Roche estimating and report forms. The book may be obtained from W. Earle Roche, 128 Western Avenue, Glendale 1, Calif. Price, $100.00.

*The Story of Safety* is a comprehensive account of du Pont de Nemours & Company's accident-prevention practices and policies which have resulted in the enviable record of only 0.67 lost-time accidents per million man-hours worked in 1951. The 28-page book is divided into sections that deal with every phase of the corporation's activities. Though primarily a manufacturer of chemicals, it is interesting to note that the accident rate of its big construction division is some 40 times lower than that of the industry at large. The final chapter tells about the search by du Pont scientists for the hidden causes of accidents attributable to carelessness and human failure.

A descriptive flier on Denver Equipment Company's new Super Rougher Flotation Machine now in production is obtainable by addressing requests to 1400 Seventeenth Street, Denver 17, Colo.

The Louis Allis Company, Milwaukee 7, Wis., has announced the publication of a 12-page bulletin covering its line of explosionproof electric motors. Special features and typical uses of these units are discussed. Write for Bulletin No. 800.

A 24-page pipe-thread manual giving complete information on design, gauging and specifications for the three major standard pipe-thread systems has been printed by Detroit Tap & Tool Company, 8615 East 8-Mile Road, Baseline, Mich. The book also contains specifications for taper and straight pipe taps, thread plug and ring gauges, and plain plug and ring gauges. Write on firm letterhead for Manual C-52.

Bulletin 731 obtainable from Lindberg Engineering Company, 2450 West Hubbard Street, Chicago 12, Ill., describes its entire line of air cylinders. Tables, diagrams and pictures list capacities and show structural features and mountings.

Literature released by Flexible Tubing Corporation, Guilford, Conn., describes its line of flexible ducts ranging in diameter from less than one inch to 30 inches. Information on special connections and couplings is included. Ask for Catalogue C2-3.

The D'Este Division of Kaye & MacDonald, Inc., 11-15 Central Avenue, West Orange, N. J., has released Bulletin 535 covering its line of steam-pressure regulating valves, including three new types. A section on choosing a regulating valve should prove helpful to users.

A 6-page folder has been issued by the Pacific Tube Company describing its line of cold-drawn steel tubing and containing information of value to users of products of this kind. Address requests for Bulletin 10 to J. E. Eicholtz, 5763 Smithway Street, Los Angeles 22, Calif.

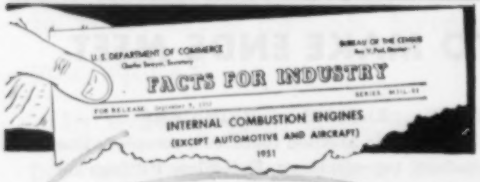
Five tests for the positive identification of wrought-iron pipe are given in a recent publication issued by A. M. Byers Company, Clark Building, Pittsburgh, Pa. The brochure also tells why that is important and explains preventive measures against the use of substitutes.

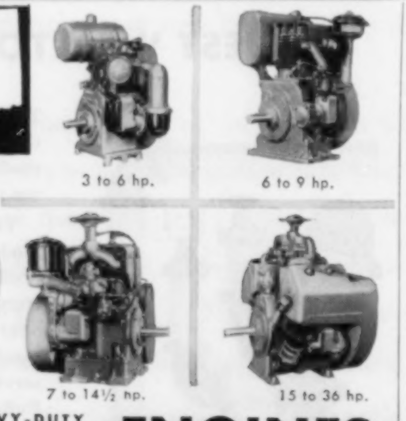
A recent folder by The Howe Scale Company, Rutland, Vt., describes its complete line of axle-load scales for checking weights of motor trucks and trailers at warehouses, industrial plants and highway installations to prevent overloads and thus protect commercial carriers from stoppages for overloads, fines and load transfers. Ask for Form No. 682.

To clear up misunderstandings regarding American standard taper and straight pipe threads, The Eastern Machine Screw Corporation, 140 Truman Street, New Haven, Conn., is distributing a folder which reviews the different types available, lists their functions and gives their proper designating letters. When writing for a copy ask for *Die Headlines*, Vol. 4, No. 1.

A 12-page bulletin (GEA-5754) on automatic voltage stabilizers ranging from 15 to 5000 volt amperes has been announced by General Electric Company, Schenectady 5, N. Y. It contains photographs and diagrams of the equipment, explains principles of operation and construction and deals with the causes and effects of voltage variations. Typical applications are listed.

Thiokol Liquid Polymer, LP-2, a viscous liquid which changes into a tough resilient, solvent-resistant rubber at room temperature, is the subject of a folder that can be obtained upon request from the Thiokol Corporation, Trenton 7, N. J. Besides describing the properties of the compound, it suggests and illustrates applications, including impregnation, gasketing, and its use as a protective coating.


U. S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
FACTS FOR INDUSTRY
INTERNAL COMBUSTION ENGINES
(EXCEPT AUTOMOTIVE AND AIRCRAFT)
1951



Proof of Top Preference for

**WISCONSIN HEAVY-DUTY *Air-Cooled* ENGINES**

**Based on data contained in a "Facts for Industry" report released on Sept. 5, 1952 by the U. S. Bureau of the Census, an aggregate average of 50.61% of all carburetor type internal combustion engines produced during 1950-'51 within an 11 to 175 cu. in. displ. range (approx. 3 to 40 hp.) were WISCONSIN HEAVY-DUTY AIR-COOLED ENGINES (exclusive of aircraft, automotive, outboard marine and "captive" engines built by various manufacturers for use on their own equipment).**

**Here is positive proof of top preference for Wisconsin Engines both by original equipment manufacturers and users of power-operated equipment. Proof of constantly growing recognition of the special adaptability of these fine engines to fit both the machine and the job. Proof of heavy-duty dependability and trouble-free air-cooling under weather and climatic extremes.**

Wisconsin general-purpose Air-Cooled Engines have been *pre-judged* and *pre-selected* by more power-wise purchasers than ALL other makes of engines combined, within a 3 to 40 hp. power range. Perhaps it's your turn to specify "Wisconsin". Descriptive literature and engineering data on request.

MOST H.P. HOURS

**WISCONSIN MOTOR CORPORATION**
*World's Largest Builders of Heavy-Duty Air-Cooled Engines*
MILWAUKEE 46, WISCONSIN

# Seagoing compressors stay ship-shape
## *. . . with help of TIMKEN® bearings*

THESE Ingersoll-Rand type 40 compressors provide air for general ship service on a tanker. To assure a steady supply of air and to keep maintenance to a minimum, Ingersoll-Rand mounts the crankshaft on Timken® tapered roller bearings.

Timken bearings carry both radial and thrust loads in any combination due to their tapered design. Shaft and adjacent parts are held in proper alignment. Wear is minimized.

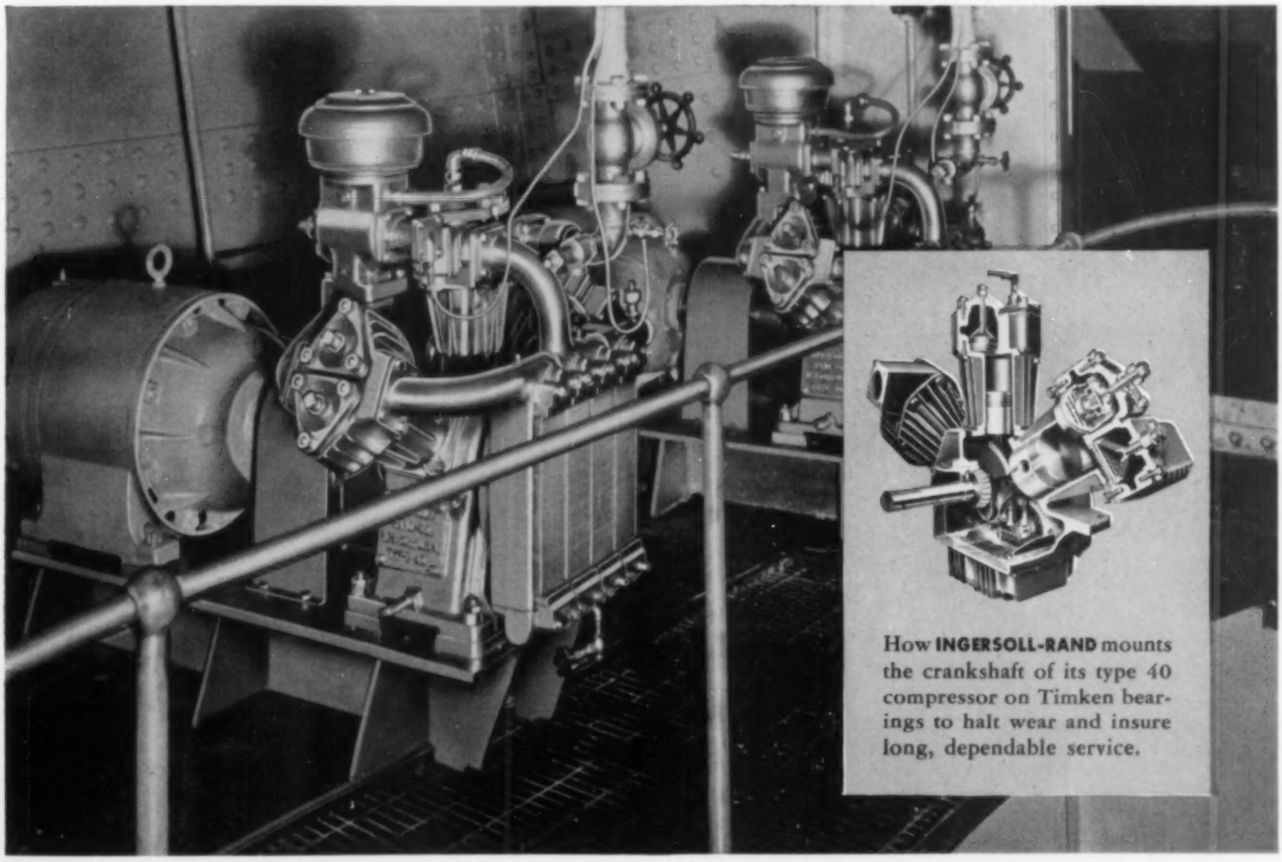
Because Timken bearings hold shafts and housings concentric, closures are more effective. Dirt and moisture are kept out—lubricants are retained. Lubrication time and costs are reduced.

Line contact between rollers and races gives Timken bearings extra load-carrying capacity. Their incredibly smooth surface finish and true rolling motion practically eliminate friction.

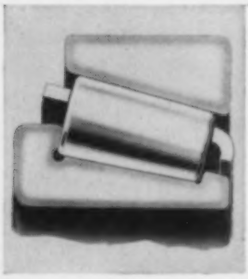
Timken bearings are precision made, engineered for the job and made of fine alloy steel. Under normal use and conditions, they last the life of the machine.

No other bearing can offer you all the advantages you get with Timken bearings. Specify them by name for machinery you buy or build. Look for the trade-mark "Timken" stamped on the bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

*This symbol on a product means its bearings are the best.*



How **INGERSOLL-RAND** mounts the crankshaft of its type 40 compressor on Timken bearings to halt wear and insure long, dependable service.



**GREATER LOAD AREA**

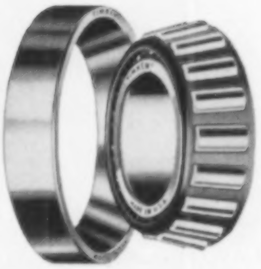
Because the load is carried on the *line* of contact between rollers and races, Timken bearings carry greater loads, hold shafts in line, wear longer.

The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

**TIMKEN**

TRADE-MARK REG. U. S. PAT. OFF.

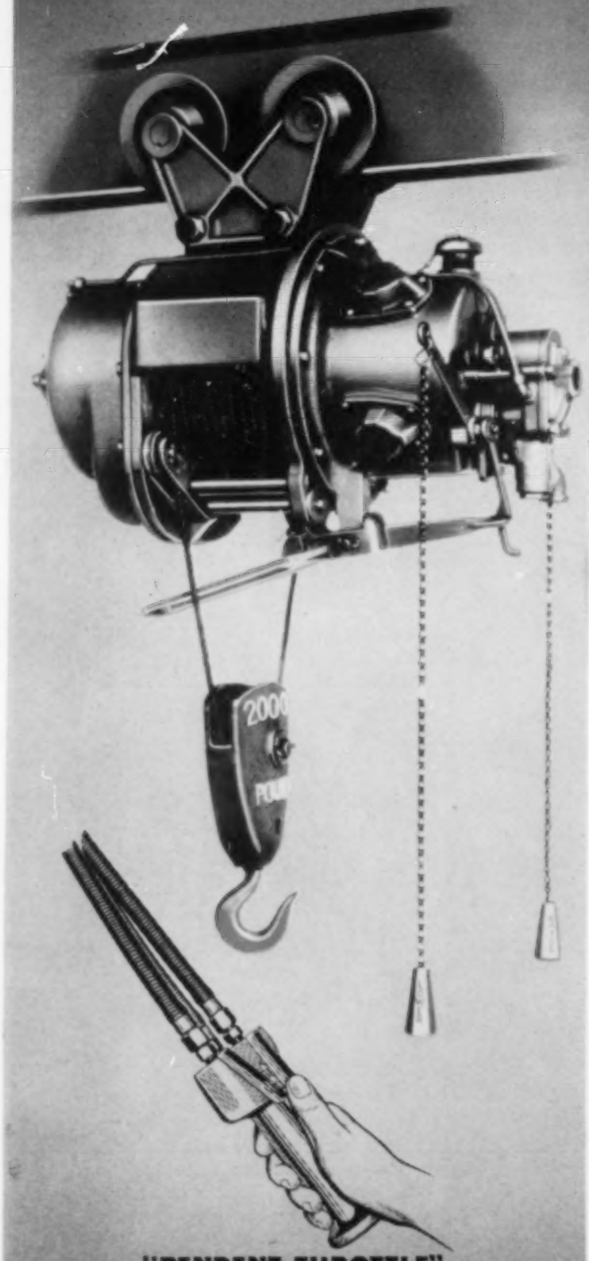
***TAPERED ROLLER BEARINGS***



**NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL AND THRUST → ← LOADS OR ANY COMBINATION**

# WHY PRODUCTION MEN

# *Choose* AIR HOISTS



**HEAT—DAMPNESS—DIRT—WON'T HURT AIR HOISTS**

Operating without the use of surrounding air for cooling, Ingersoll-Rand Air Hoists utilize internal pressure to keep out wet, hot, explosive or dirty atmospheres. They can be relied on for continuous operation with the minimum of maintenance. All moving parts are automatically lubricated.

**COMPLETELY SAFE—LOAD CAN'T DROP**

The Automatic Brake releases with air pressure only when the throttle is opened; therefore, even if the air supply should fail, the load cannot drop. The Automatic Safety Up- and Down-Stops prevent overrunning in both directions.

**LIFT CONTROL FROM A SLOW CREEP TO TOP SPEED**

The graduated Reverse Valve gives the operator complete control and permits accurate and easy spotting of the load. A Poppet-type Throttle prevents wasteful air leakage.

**MORE HORSEPOWER PER POUND OF WEIGHT**

Pound for pound Air Motors have more horsepower. There are eighteen standard sizes of Ingersoll-Rand Air Hoists, all having low air consumption, with capacities up to 20,000 pounds.

**RUGGED CONSTRUCTION KEEPS THEM ON THE JOB**

The time proven 4 cylinder, radial Air Motor features ball bearing support throughout, anti-friction bearings in the top hook and hook block, a groove type rope drum and a planetary gear system. All contribute to Ingersoll-Rand's reputation for dependability—many Hoists are still on the job after 20 years or more.

*For special applications Ingersoll-Rand builds long-lift, low-head room and high capacity hoists. Let our application engineers make their recommendations without obligation to you.*

801-8

**"PENDENT THROTTLE"**

**ANOTHER IR FIRST**

The only complete line of air hoists with convenient one hand control

**Ingersoll-Rand**

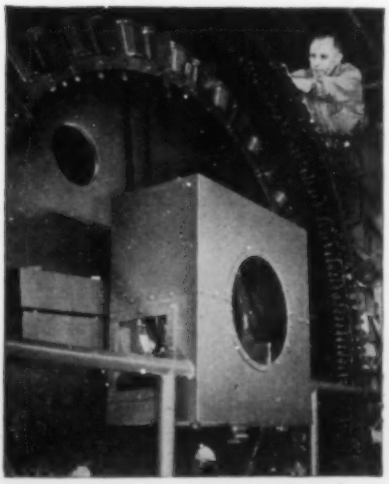
11 BROADWAY, NEW YORK 4, N. Y.

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

Elliott
FABRI-STEEL
MOTORS AND GENERATORS

# Another big low-speed motor by..... ELLIOTT

**A large low-speed engine type synchronous motor with split rotor, for driving Ingersoll-Rand type PRE reciprocating gas compressor.**



Close-up of the pressurized explosion-resisting collector ring enclosure.

This big motor is rated 2000 hp, 164-rpm, 4000 volts, 3 phase, 60 cycle, 50 C rise, 1.0 power factor. The split rotor facilitates assembly on the compressor shaft in the field. Collector rings are enclosed, adapting the unit to duty in explosive gas atmosphere.

Elliott has established a particularly strong reputation in large motors designed for specific and individual conditions, such as the one illustrated here. An exceptional degree of rigid ruggedness is gained by the famous Elliott "Fabri-Steel" construction while high performance and endurance are assured by quality workmanship throughout.

For full details write for Synchronous Motor Bulletin PB5000-1.

R2-2

**ELLIOTT COMPANY**
**Ridgway Division Ridgway, Pa.**
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.
*DISTRICT OFFICES IN PRINCIPAL CITIES*

ECo

# "It Throws It Over Its Shoulder"

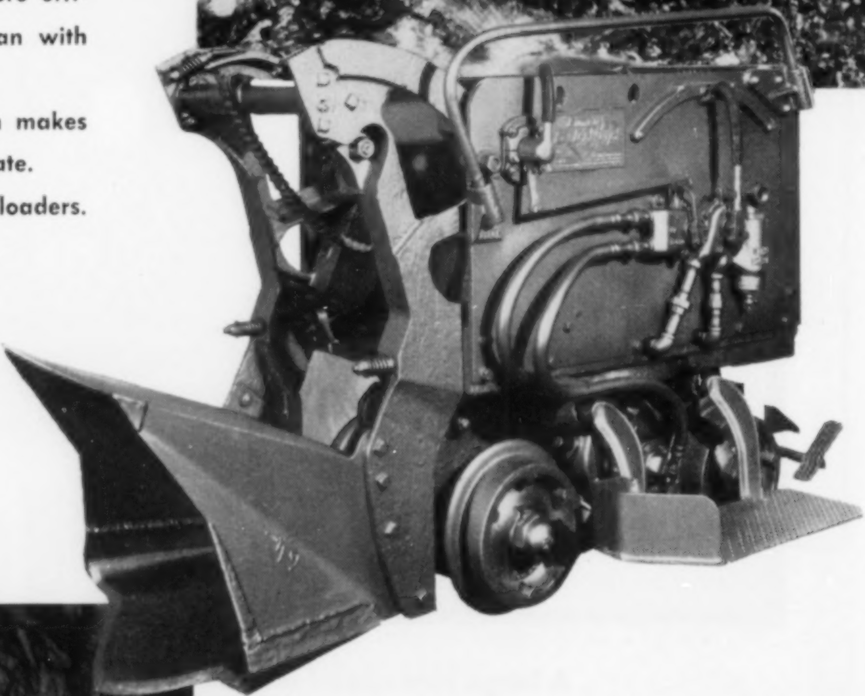
This is the way a famous news broadcaster explained the operation of an Eimco loader on a recent TV program remarking on the speed of the machine as seen in the Uranium fields.

Speed and dependability are the most desirable features in any loading machine today. These are the two most prominent features of all Eimco loaders.

The Eimco design permits faster, more efficient operation with greater safety than with any other loading equipment.

Its heavy-duty cast-steel construction makes it the most dependable, easiest to operate.

Write for information on Eimco loaders. There's an Eimco for every loading job.



Above — Eimco Model 21 Loader available for track gauges from 18" to 48" and with coupler to couple your car. Powered by two powerful Eimco 5-cylinder radial type air motors.

**EIMCO** A422

**THE EIMCO CORPORATION**

*The World's Largest Manufacturers of Underground Rock Loading Machines*

EXECUTIVE OFFICES AND FACTORIES — SALT LAKE CITY 10, UTAH, U. S. A.

*BRANCH SALES AND SERVICE OFFICES:*

NEW YORK, 51-52 SOUTH STREET • CHICAGO, 3319 SOUTH WALLACE STREET
BIRMINGHAM, ALA., 3140 FAYETTE AVE • DULUTH, MINN., 216 E. SUPERIOR ST.
EL PASO, TEXAS, MILLS BUILDING • BERKELEY, CALIF., 637 CEDAR STREET
KELLOGG, IDAHO, 307 DIVISION ST. • LONDON W. 1, ENGLAND, 190 PICCADILLY

IN FRANCE: SOCIETE EIMCO, PARIS, FRANCE
IN ENGLAND: EIMCO (GREAT BRITAIN) LTD., LEEDS 12, ENGLAND
IN ITALY: EIMCO ITALIA S.P.A., MILAN, ITALY

Meet the

# HANSEN

Representative

## QUICK-CONNECTIVE COUPLINGS ARE HIS BUSINESS . . .

## —But so are air line problems

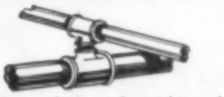
If you have fluid lines where quick connection and disconnection will save you time and money, the Hansen representative in your area can supply you with exactly the right shut-off or straight-through coupling for your particular application.

Furthermore—and equally important—he can often make suggestions to help you eliminate troublesome difficulties in your fluid line circuit. From years of experience in close contact with hundreds of plants, he can make practical suggestions to give you vastly improved performance from your present installation.

If you aren't already making use of his know-how, call the Hansen representative the next time you run into difficulties. He talks "shop language" which may supply exactly the information you need.

*Here's just one suggestion from*

**THE HANSEN HOOK-UP**



The accumulation of condensed moisture in air lines can be effectively controlled when take-off connections are correctly made as shown in the above illustration. With this hook-up, condensed moisture will not pass beyond connection—is easily removed with properly located drains.

***REPRESENTATIVES***

BALTIMORE
BIRMINGHAM
CHICAGO
CLEVELAND
DALLAS
DAYTON
DENVER
DETROIT
FT. WAYNE
HARTFORD
KANSAS CITY
LOS ANGELES
LOUISVILLE
MILWAUKEE
MINNEAPOLIS
NEW ORLEANS
PITTSBURGH
ROCHESTER
SAN FRANCISCO
SAVANNAH
SEATTLE
ST. LOUIS

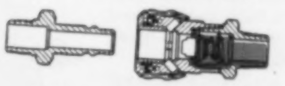
MONTREAL
TORONTO
VANCOUVER

*Export Department:* CLEVELAND

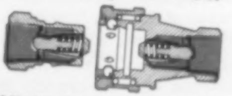
**QUICK-CONNECTIVE FLUID LINE COUPLINGS**

**1.** QUICK CONNECTION AND DISCONNECTION **2.** INSTANT AUTOMATIC FLOW OR SHUT-OFF

One-Way Shut-Off



Two-Way Shut-Off



ALSO STRAIGHT-THROUGH QUICK-CONNECTIVE COUPLINGS

***Send for Catalog!***

**THE HANSEN MANUFACTURING COMPANY**

4031 WEST 150th STREET • CLEVELAND 11, OHIO

**NEW FRACTIONAL H.P. STARTER HAS ALL THE FEATURES!**

- Quick-make, quick-break contact mechanism
- Single or double pole construction
- Double-break contacts of fine silver
- Modern styling
- Straight-thru wiring with convenient terminals—generous wire space
- Dependable melting alloy type overload protection—trip-free
- Definite trip indication
- Interchangeable overload relay units accessible from the front
- Open type starter can be used with standard switch box and flushplate

***RATINGS:***
*Double pole: 1 H.P., 115—230 volts A.C. or D.C. Single pole: 1 H.P., 115—230 volts A.C. and ½ H.P., 115—230 volts D.C.*

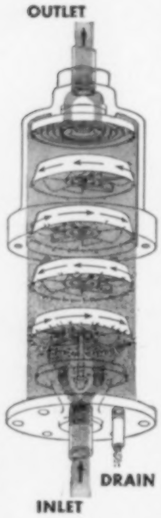
*Write* for Bulletin 2510A. Address Square D Company,
4041 N. Richards St., Milwaukee 12, Wisconsin.
ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

**SQUARE D COMPANY**

**EQUIPMENT LASTS LONGER . . . PERFORMS BETTER . . . when the**

**ARIDIFIER**

**SCRUBS, CLEANS AND DRIES On Air and Gas Lines**

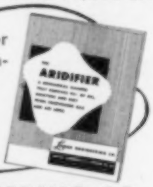


**LASTS LONGER because . . .** The Aridifier's patented centrifugal-baffle action traps 92% of all dirt, oil, scale and water in gas or compressed air . . . and drains off these troublemakers *before* they can damage tools and equipment.

**PERFORMS BETTER because . . .** The Aridifier protects tools against the freezing, fouling, caking and corrosion caused by dirt and foreign matter . . . assures the clean, dry air and gas that means better spray work, painting, lacquering, sand blasting, air cleaning, and similar operations.

**Easily installed, the Aridifier maintains itself. 10 models. Capacity range; 7 CFM to 17,000 CFM.**

Learn HOW the Aridifier scrubs with a patented centrifugal-baffle action.
**Write for This Catalog Now!**



**Logan ENGINEERING CO.**
4915 W. Lawrence Ave., Chicago 30, Ill.

**NOPAK Cylinder Saves 92 HAND TURNS**

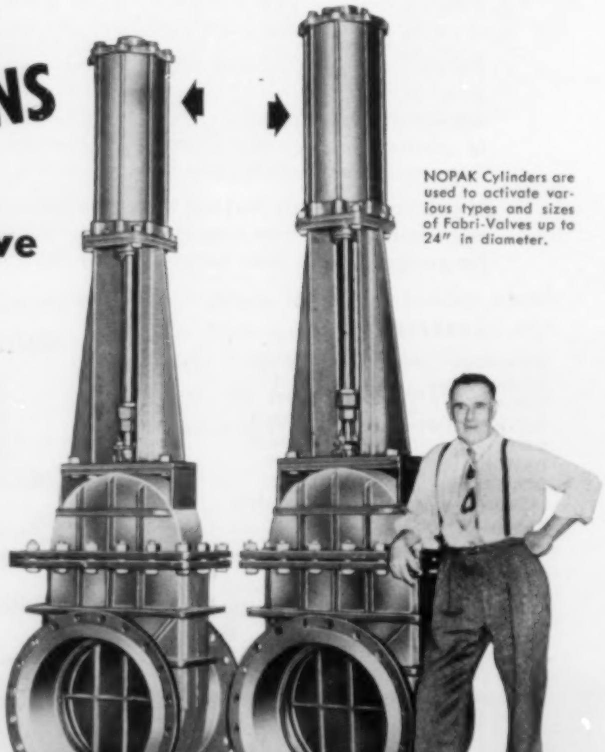
**— in opening or closing 24" Wedge-Gate Fabri-Valve**

Many installations of Wedge-Gate and Bonnet-Stock Valves are activated by NOPAK Cylinders for faster, more efficient operation. For example, a NOPAK 10" Model "D" Water Hydraulic Cylinder will open or close a 24" Wedge-Gate Valve, as pictured, in a few seconds. If manually operated, these 24" valves require 92 full turns of a handwheel for each opening or closing . . . consuming many minutes of costly manual labor.

The Fabri-Valve Co., Portland, Ore., states that these valves handle vapor from 50 p.s.i. to 150 p.s.i. Such valves are also used in liquor control lines, in paper mills, and as sea chests aboard many types of merchant ships. NOPAK Cylinders, controlled by NOPAK all-bronze 4-way valves, are used as activators because of their uniformity in design, adaptability to various types of Fabri-Valves, and their ease of installation.

You can gain these and other benefits in specifying NOPAK Cylinders and Valves for the efficient application and control of air or fluid power.

**GALLAND-HENNING MFG. CO.**
2759 S. 31st Street • Milwaukee 46, Wis.



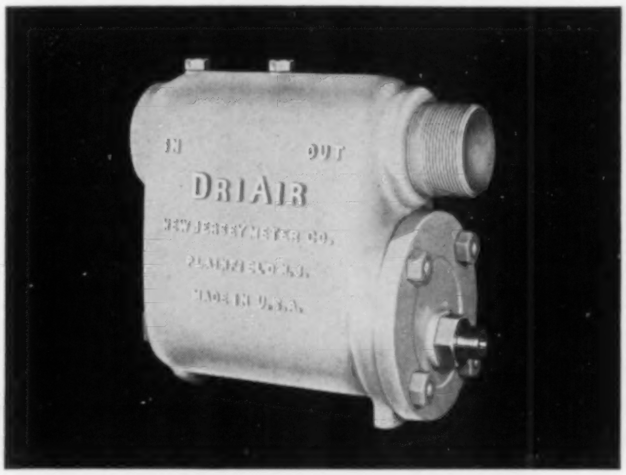
NOPAK Cylinders are used to activate various types and sizes of Fabri-Valves up to 24" in diameter.

Refer to Sweet's File for Product Designers or write for Bulletin SW-1.
•
*Representatives in Principal Cities*

**NOPAK**
***VALVES AND CYLINDERS***
**DESIGNED for AIR and HYDRAULIC SERVICE**

A 7277-½H

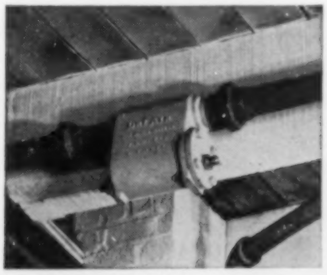
# DEPENDABLE PNEUMATIC SERVICE



## WHEN EQUIPMENT IS PROTECTED BY

# DRIAIR

## A COMPLETE SELF-CONTAINED UNIT



DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected.

DRIAIR speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request.

# NEW JERSEY METER COMPANY

PLAINFIELD, NEW JERSEY

# "MINE KING"

GOODALL RUBBER CO. INC.
G
R
C
INC.
MINE KING AIR

## *The* AIR HOSE *That Cuts Drilling Costs Three Ways*

Use of "MINE KING" Air Hose assures important economies in drilling operations, regardless of conditions.

Its tougher, more durable construction keeps it on the job longer—a saving in hose replacement costs.

Extreme flexibility provides easier handling and facilitates drilling in tight spots and coiling for transport.

Availability in extra long lengths reduces the need for intermediate connections to an absolute minimum — fewer couplings required — less time for setting up the lines.

"Mine King" is a Goodall "Standard of Quality" product, made in sizes ½", ¾" and 1", double and triple cord, maximum lengths of 500 feet.

*Contact Our Nearest Branch for Prices*

PARTICIPATING IN THE MANAGEMENT AND FINANCING OF KENTUCKY SYNTHETIC RUBBER CORPORATION

**GOODALL RUBBER COMPANY**

Est. 1870

GENERAL OFFICES, MILLS and EXPORT DIVISION, TRENTON, N. J.
Branches: Philadelphia - New York - Boston - Pittsburgh - Chicago - Detroit - St. Paul - Los Angeles
San Francisco - Seattle - Portland - Salt Lake City - Denver - Houston - Distributors in Other Principal Cities
Goodall Rubber Company of Canada, Ltd., Toronto.

**FLUOR**

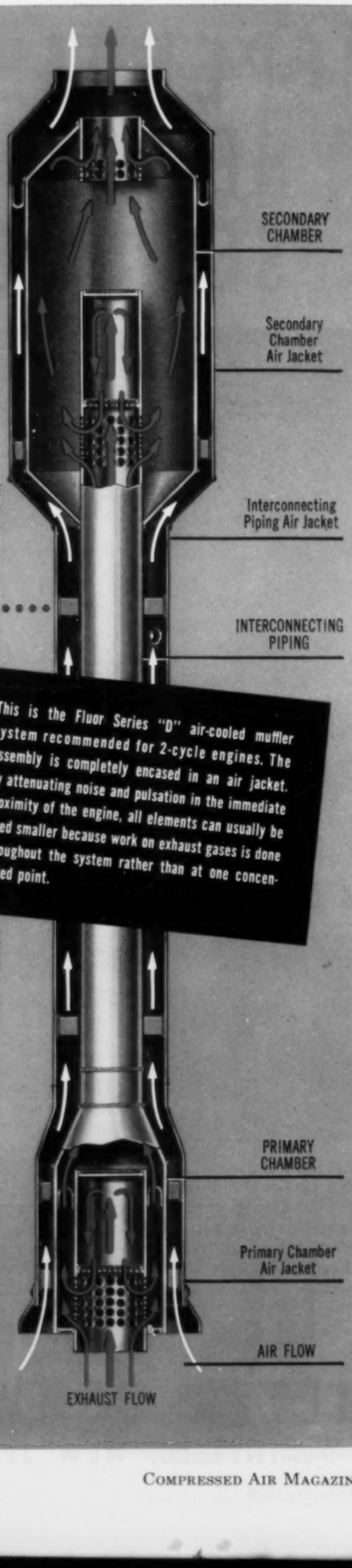
**air-cooled MUFFLERS**

**Eliminate exhaust-line insulation**
**Ventilate engine rooms**
**Reduce maintenance and repairs**
**Have longer operational life**

The cutaway illustration explains better than words just how Fluor air-cooled muffler systems utilize exhaust energy to accomplish a multiple-cooling action. As exhaust gases are ejected into the atmosphere, a flow of air is also started through the outer air jacket (via the Venturi principle) and expelled with the exhaust at the rate of 3 of air to 1 exhaust, by weight. Depending upon circumstances, this air to exhaust ratio often exceeds the specified limit.

The air stream keeps the muffler chambers and interconnecting pipe cool, eliminates the need for exhaust-line insulation, ventilates the engine room and reduces spark hazard. Air cooling prolongs the life of mufflers by reducing corrosion due to heat. And, in many instances, water-cooled manifolds have been replaced with Fluor air-cooled muffler-manifold systems with excellent results.

Fluor Mufflers are available in the Series "D" (shown here), a dual-element system for 2-cycle engines, and in the Series "C", a single-element system for 4-cycle engines. Fluor Mufflers may be purchased with or without air-cooling features, with bottom or side inlets, and for engines in the 150 to 3500 H.P. class of virtually every make and model. For detailed information, write for Bulletin FM-8501.


SECONDARY CHAMBER
Secondary Chamber Air Jacket
Interconnecting Piping Air Jacket
INTERCONNECTING PIPING
PRIMARY CHAMBER
Primary Chamber Air Jacket
AIR FLOW
EXHAUST FLOW

This is the Fluor Series "D" air-cooled muffler system recommended for 2-cycle engines. The assembly is completely encased in an air jacket. By attenuating noise and pulsation in the immediate proximity of the engine, all elements can usually be sized smaller because work on exhaust gases is done throughout the system rather than at one concentrated point.

**FLUOR**

*Engineers - Constructors - Manufacturers*

THE FLUOR CORPORATION, LTD., LOS ANGELES 22, CALIFORNIA
New York, Chicago, Pittsburgh, Tulsa, Houston, San Francisco

Represented in the Sterling areas by:
Head Wrightson Processes Ltd., Teesdale House, Baltic Street, London, E.C.1., England

SINCE 1890

BE *sure* WITH FLUOR

# IT ALL BEGAN IN '33

## another important story about

# 4-CYCLE V-ANGLE COMPRESSORS

*Repeated installations of Ingersoll-Rand Gas-Engine Driven Compressors keep pace with steady growth of Lloyd Corporation, Ltd. of California Gas Booster plant*

When Lloyd Corporation, Ltd. back in '42, built its booster plant in Ventura, Cal., it selected a 300-hp Ingersoll-Rand XVG compressor for gas-lift service. The XVG had revolutionized oilfield practices when it was introduced in 1933 as the first V-angle gas-engine-driven compressor, and had quickly achieved world fame and acclaim for its outstanding performance in all kinds of services.

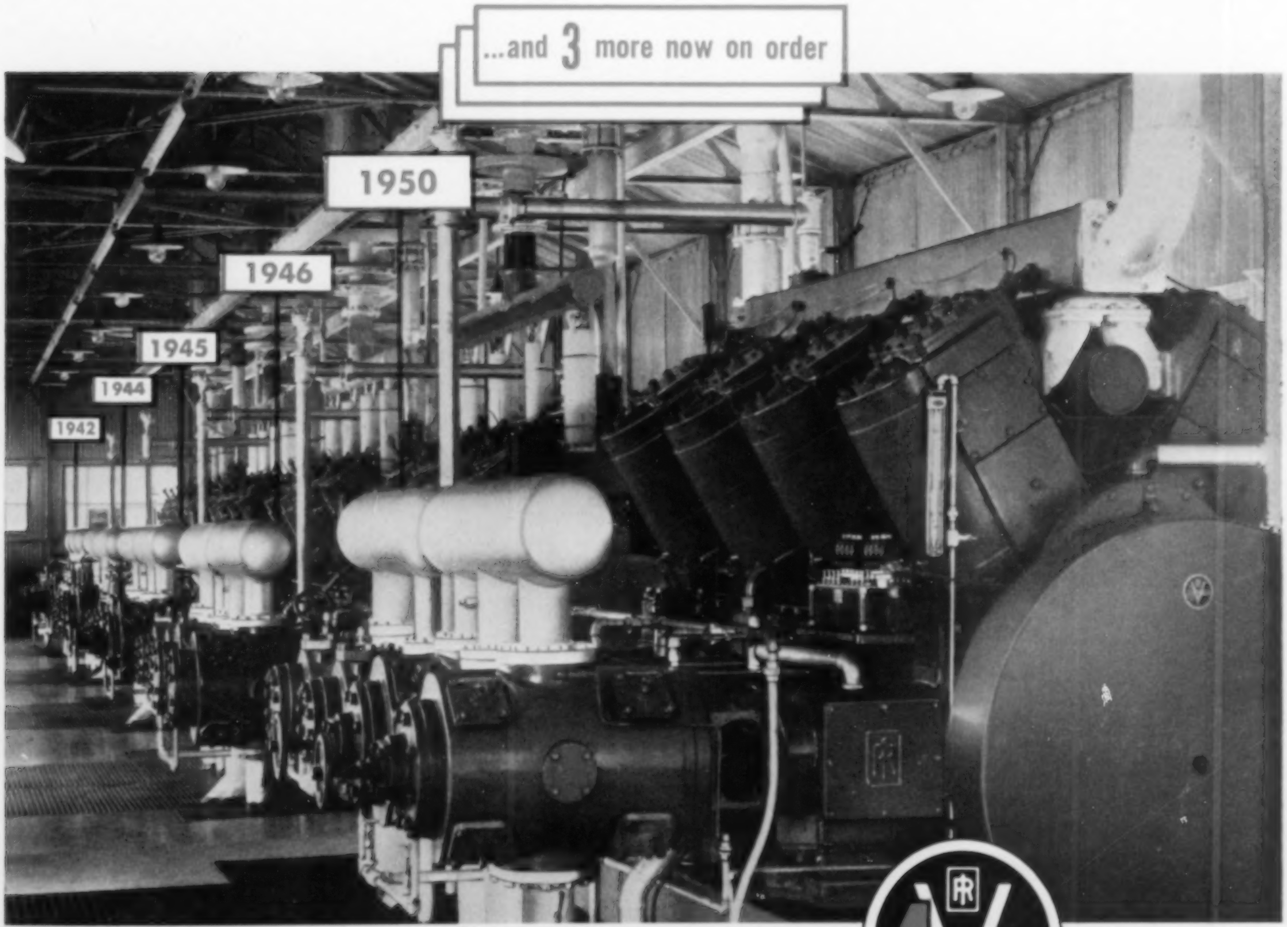
After two years' first-hand experience with its XVG, Lloyd installed another one . . . and additional units in '45 and '46.

Then in 1950 it purchased a different compressor. This machine was also an Ingersoll-Rand, and fit into the same amount of space . . . had the same number of cylinders. And it had all of the important, proven, and desirable features of the XVG.

But it had 45% more capacity. It incorporated many new and advanced design features that make it an even better machine. This was the modern design of the famous XVG. It is known as the SVG . . . made in three sizes, 330, 440 and 550 horsepower.

Lloyd liked the SVG, too. They ordered three more, two for '52 and one for delivery in early '53.

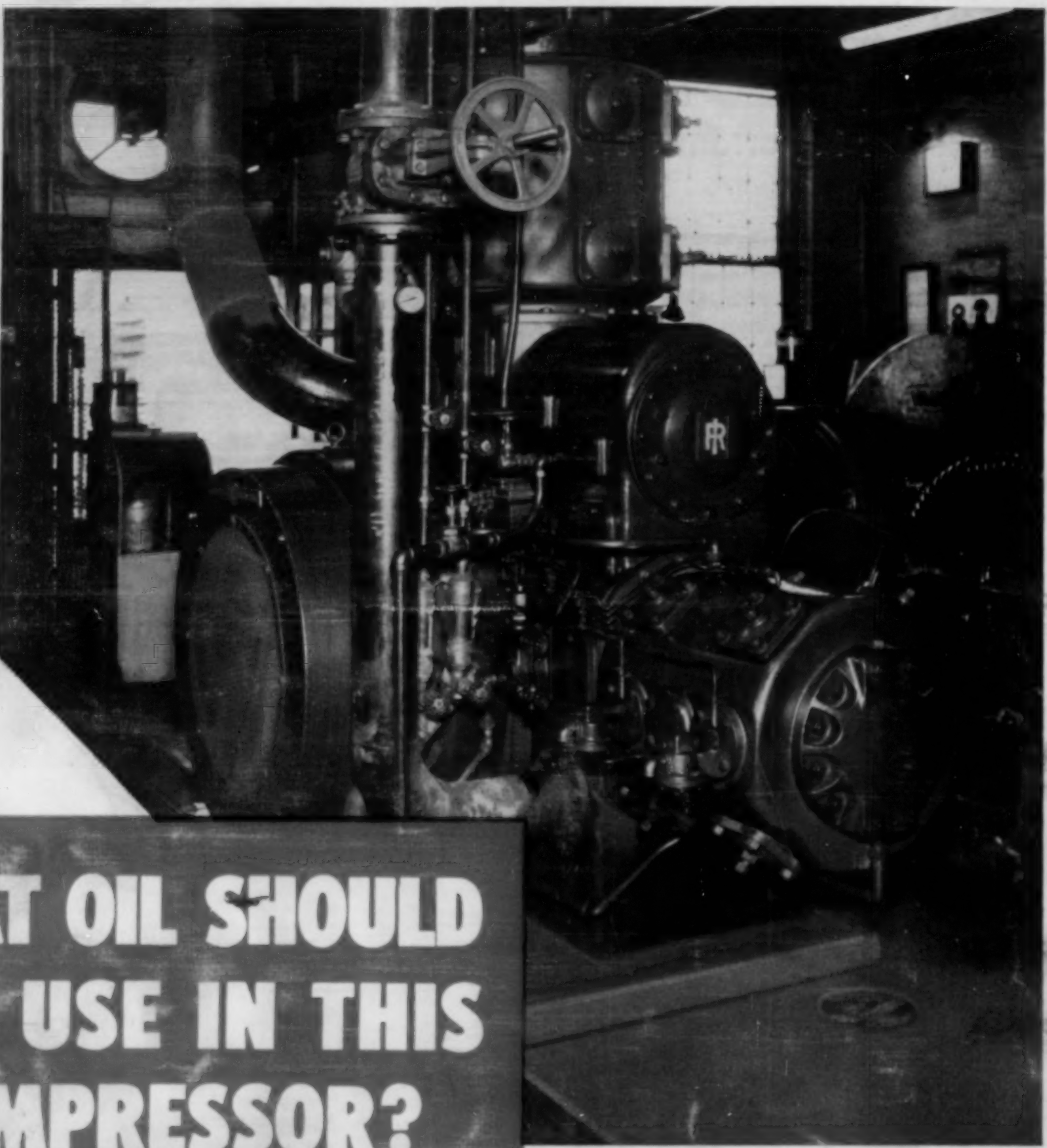
Let your I-R representative tell you more about the SVG and the other units in the full line of Ingersoll-Rand 4-cycle gas engines and compressors.



IR 4-CYCLE V

**Ingersoll-Rand**
11 BROADWAY, NEW YORK 4, N. Y. 840-6

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES



WHAT OIL SHOULD YOU USE IN THIS COMPRESSOR?

**THE RIGHT ANSWER** is: the oil that can assure clean, low-cost compressor performance *under the particular operating conditions.* And the surest way to get that oil is to call in Texaco.

Knowing that no one oil can be all things to all compressors, Texaco makes *a complete line* of air compressor oils—covering every operating condition, every type and size of compressor. Thus, you can always get a Texaco air compressor oil that's exactly right for you.

A Texaco Lubrication Engineer will gladly help you choose it. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

☆ ☆ ☆

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO Air Compressor Oils

FOR ALL OPERATING CONDITIONS

TUNE IN . . . TEXACO STAR THEATER starring MILTON BERLE, on television Tuesday nights. METROPOLITAN OPERA radio broadcasts Saturday afternoons.